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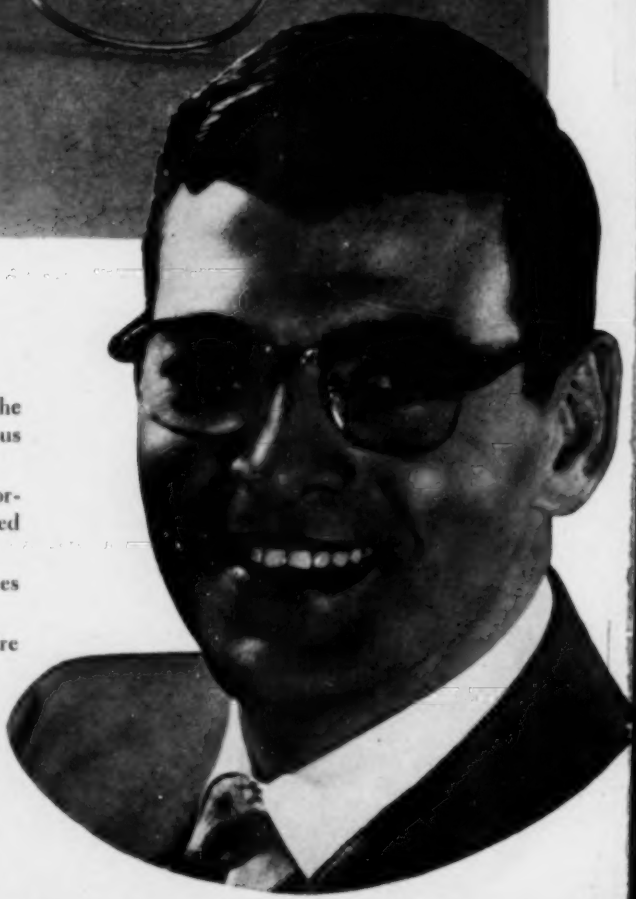

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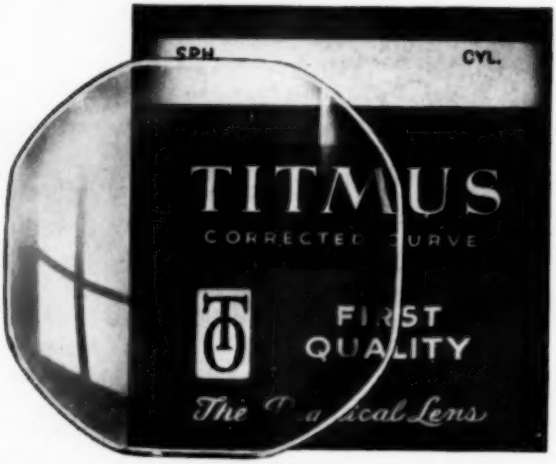

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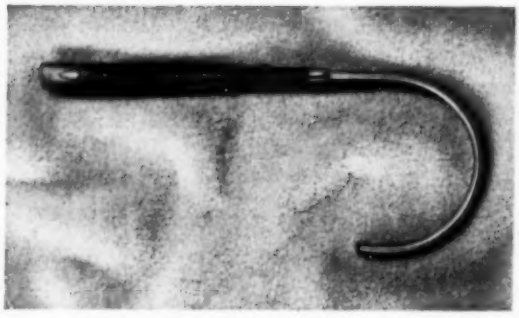

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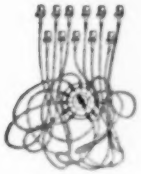

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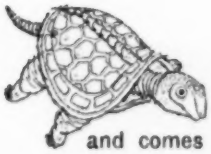

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THE PRESCRIPTION OF VISUAL TRAINING BY A GRAPHICAL METHOD*

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Columbus, Ohio

During the last decade, the interest of optometrists in visual training in general and orthoptics in particular has been gradually increasing. This interest stems from the need of patients for visual training for comfortable and efficient vision. To meet the needs of the optometrists in rendering this service many different instruments have been developed: the essential design of most of these instruments, however, is the Brewster stereoscope. It is the purpose of this paper to review the different methods for obtaining prismatic effects with this instrument and to illustrate a graphical method for prescribing stereoscopic training.

THE BREWSTER STEREOSCOPE

The optical components of the Brewster stereoscope consist of paired plus lenses. These lenses are usually mounted in a housing so that they can be held conveniently before the eyes. In one design a bar is attached to the housing midway between the lenses: a holder which is mounted but movable on the bar holds the targets or stereograms. In another design, separate tracks are provided for the targets for the right and left eyes. Suitable adjustments permit changes in angular position of the tracks. In a third design, the targets are kept at a relatively fixed distance from the lenses but adjustments are provided for altering the lateral and/or vertical position of the targets.

*Read before the annual meeting of the American Academy of Optometry, Section on Orthoptics, Rochester, New York, December 8, 1952. For publication in the November, 1953, issue of the AMERICAN JOURNAL OF OPTOMETRY AND ARCHIVES OF AMERICAN ACADEMY OF OPTOMETRY.

†Optometrist, Ph.D., Associate Professor of Optometry. Fellow, American Academy of Optometry.

MATHEMATICAL ANALYSIS

It has been shown that the prismatic effect of the Brewster stereoscope can be computed by the equation

$$P = 2(rU' + qD).$$ [1,2]

In this equation U′ is the dioptral value of the image distance and D is the power of the lenses. The distances r and q, measured in cms., represent the lateral position of the targets in the actual plane and in the focal plane of the lenses respectively. These distances are illustrated in Figure 1. It should be noted that they have a directional value and are positive only when measured from left to right.

In deriving the above equation, reference is made to the orthoptic positions for different stimuli to accommodation. These positions are defined as the settings of the targets that provide the same stimuli to accommodation and convergence as would normally be encountered at different distances of fixation without a stereoscope.

It can be shown that the plot of the points representing the orthoptic positions fall on the lines FM in Figure 1. For settings of the targets

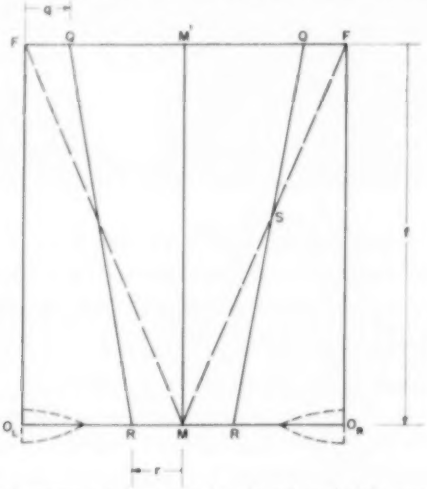

Fig. 1. The optical centers of the lenses for the left and right eyes are indicated as L and R. M is the midpoint of the line connecting L and R. The line QR represents the path of the targets when moved from infinity to a near position. The connotations of q and r are apparent from the figure.

closer together than the orthoptic position for any value of U′, a base-out effect is produced; if the targets are set farther apart than the orthoptic position a base-in effect is obtained.

A number of interesting possibilities become evident from a study

of the above relationship. For example, either r or q can be set to zero. If r is set to zero, the prismatic effect is

$$P = 2\ qD.$$

This relation states that the prismatic effect is constant for all stimuli to accommodation. If q is set to zero, then

$$P = rU'.$$

This relationship is interesting since the prismatic effect now is directly proportional to the stimulus to accommodation. It would be applicable, for example, in the conventional stereoscope whenever the separation of the targets of the stereogram for the right and left eyes is equal to the distance between the optical centers of the lenses.

From a study of the above relations it is evident that the prismatic effects are independent of the interpupillary distance. This finding is significant since the amount of convergence for a given distance of fixation varies with the P.D.

The sign notations in the use of the formulas is important. The image distance, u′, or its dioptral equivalent, U′, are considered positive for any stimulus to accommodation. Also, positive and minus values of P represent base-out and base-in prismatic effects respectively.

EXAMPLES

For clarification of the above analysis, three examples are given. Each example is an application of the equations to a method employed in a particular instrument for producing changes in the demand on convergence.

(1) Assume that the centers of the targets in a conventional stereogram are 60 mms. apart. If the powers of the lenses are +5.00 D., and the separation of their optical centers is 70 mms., what is the prismatic effect when the targets are adjusted to provide a stimulus to accommodation of 2.50 D.?

Solution:

$$r = -6.0/2 = -3.0 \text{ cms.}$$
$$q = (7.0 - 6.0)/2 = 0.5 \text{ cms.}$$
$$P = 2(rU' + qD)$$
$$P = 2\ [-3.0\ (2.5) + 0.5\ (5.0)\,]$$
$$= -10.00\triangle$$

The minus sign indicates a base-in effect.

(2) Assume that lenses in the A-O stereo-disparator have a power of +5.00 D. If q is set at 10 mms., and r at —20 mms., compute the prismatic effect produced for a stimulus to accommodation of 5.00 D.

Solution:

$$P = 2(rU' + qD)$$
$$= 2\ [-2.0\ (5.0) + 5.0]$$
$$= -10.0\triangle$$

(3) In the Wottering Rotoscope, the lenses have a power of +5.00 D., and their optical centers are separated 70 mms. If the stimulus to accommodation is zero, what is the prismatic effect if the targets are separated 42 mms.?

Solution:

$$q = (7.0 - 4.2)/2 = 1.4 \text{ cms.}$$
$$P = 2\ qD$$
$$P = 2(1.4)\ 5.00$$
$$P = 14.0\triangle$$

The plus sign indicates a base-out effect.

GRAPHICAL ANALYSIS

From a study of the equations in the previous section, it is seen that for fixed values of D, q, and r, the prismatic effect varies with U'. Since U' represents the stimulus to accommodation, it is possible to plot these prismatic effects on the conventional "Donders Graph."[5, 6] When this is done, results similar to those illustrated in Figure 2 are obtained.

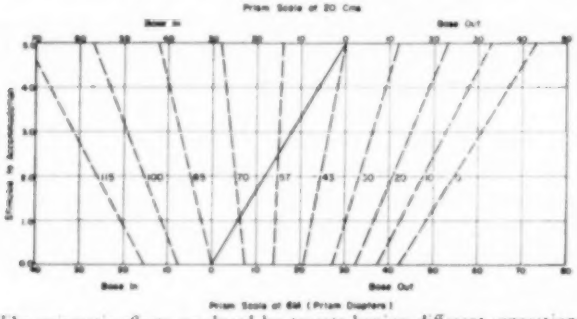

Fig. 2. The prismatic effects produced by targets having different separations are given above. For these data, the lenses were assumed to have a power of +5.00 D., with the optical centers 85 mms. apart. The line connecting the zero positions of the two scales is the normal demand line of accommodation and convergence for an interpupillary distance of 60 mms.

For Figure 2, the stimulus to accommodation is plotted as the ordinate and the prism scales at 6 M. and 20 cms., as the abscissa. Since a distance of fixation of 20 cms., for a person with a P.D. of 60 mms., requires a convergence of 30△, the zero of the prism scale for 20 cms., is located at 30△ on the 6 M. scale. The straight line connecting the zero positions of the two scales, as a consequence, represents the orthoptic

relation for different stimuli to accommodation or the so-called normal demand line.

For the data in Figure 2, the lenses were assumed to have a power of +5.00 D., with the optical centers 85 mms. apart. The various lines provide the prismatic effects obtainable with stereograms having targets for the two eyes separated by the amounts indicated on the different lines.

Several facts about the data in Figure 2 deserve attention. The stereogram with a separation of targets of 85 mms. provides no prismatic effect for a stimulus to accommodation of zero. This follows since the target is located at the focal plane of the lenses, and all rays from the central fixation point will emerge parallel to the axes of the lenses. For all finite stimuli to accommodation, base-in prismatic effects are encountered. A stereogram with a separation of 43 mms. also will produce a prismatic effect of zero but only with a stimulus to accommodation of 5.00 D. With a stimulus of less than 5.00 D., base-out effects are produced. Stereograms with separations of targets between 43 and 85 mms., will produce both base-in and base-out prismatic effects: with separations less than 43 mms., and a stimulus to accommodation of less than 5.00 D., only base-out effects are produced; with separations of more than 85 mms., only base-in effects can be obtained.

By a study of Figure 2, it also is seen that base-in prismatic effects usually are always obtained with an increase in the stimulus to accommodation. This effect is manifested either by an increase in the base-in effect if a base-in effect was obtained for a stimulus to accommodation of zero, or by a decrease in the base-out effect if the original prismatic effect was base-out. The increment of base-in effect produced per diopter of change in the stimulus to accommodation varies with the separation of the targets. In fact it is equal to the separation of the targets in cms. For targets having a separation of zero, the increment is zero; for targets having a separation of 11.5 cms., the increment is 11.5△.

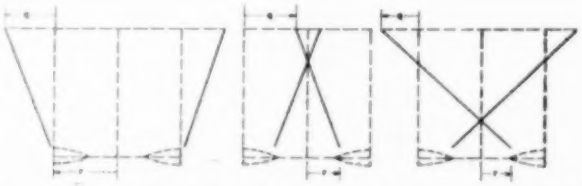

Fig. 3. Illustration of different settings of the tracks in one design of a stereoscope. Measurements to the left and right for q and r are minus and plus respectively.

To this point, the graphical analysis has been restricted to stereograms having a fixed separation of the targets. What is the effect of varying the separation with changes in the stimulus to accommodation? To answer this question assume that the targets move on tracks and that their angular relation can be altered as illustrated in Figure 3. Further, let the power of the lenses be +5.00 D. and the separation of their optical centers be 80 mms. If the limit of movement q is +3.00 to —3.0 cms., and r is —4.0 to +2.0 cms., the maximum prismatic

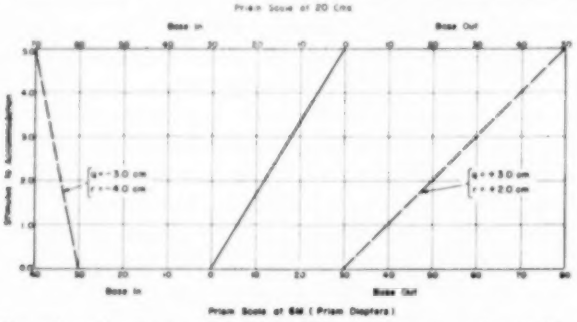

Fig. 4. The prismatic effects obtainable with an adjustment of movable tracks for q of ±3.0 cms. and r of —4.0 to +2.0 cms.

effects obtained under these conditions are shown in Figure 4. The maximum base-in effects are obtained with settings of

$$q = -3.0 \text{ cm., and} \qquad (A)$$
$$r = -4.0 \text{ cm.}$$

The maximum base-out effects are produced when

$$q = +3.0 \text{ cm., and} \qquad (B)$$
$$r = +2.0 \text{ cm.}$$

The broken lines in Figure 4 provide only the limits of the prismatic effects. Since any setting of q can be combined with any setting of r, it is possible to obtain any prismatic effect between the limits for a given stimulus to accommodation. In fact, it even is possible to combine

$$q = -3.0 \text{ cm., and} \qquad (C)$$
$$r = +2.0 \text{ cm.}$$

or,

$$q = +3.0 \text{ cm., and} \qquad (D)$$
$$r = -4.0 \text{ cm.}$$

If the prismatic effects produced by settings A and C are plotted on a single graph the data given in Figure 5 are obtained. The intermediate lines between the two limits are produced by settings of r between +2.0 cm., and —4.0 cm., with q constant at —3.0 cm. Similarly, the limits

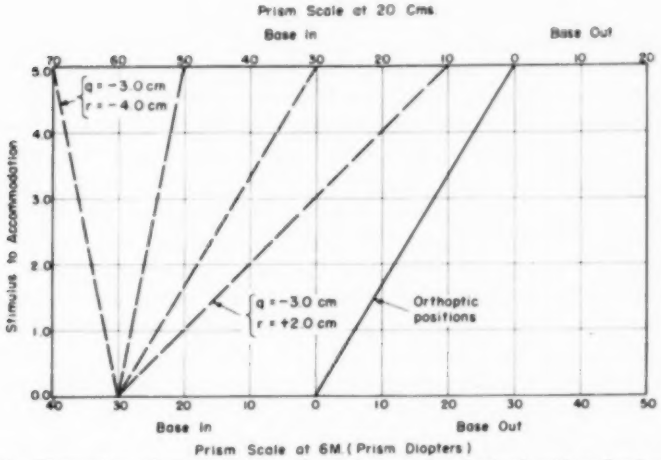

Fig. 5. Illustration of the prismatic effects that can be obtained with a fixed setting for q of —3.0 cm., and different settings for r from —4.0 to +2.0 cms.

of the prismatic effects presented in Figure 6 are obtained with settings B and D. The intermediate lines again represent only variations of r between +2.0 cm., and —4.0 cm., with q set at +3.0 cm.

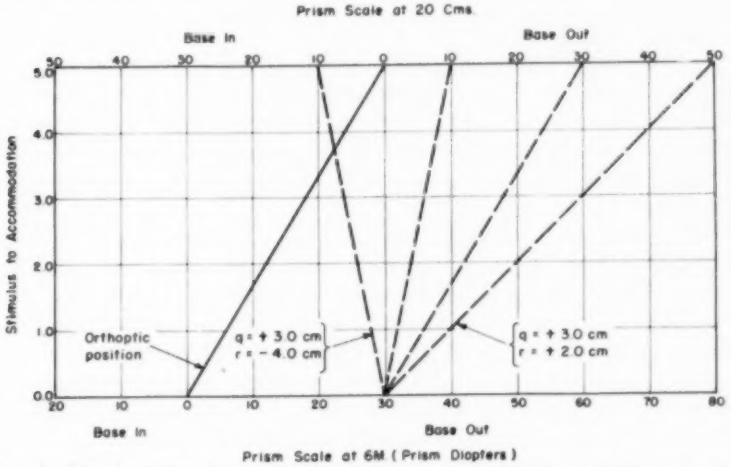

Fig. 6. For the above data, q was kept constant at +3.0 cm., and the value of r varied from +2.0 to —4.0 cms.

CLINICAL APPLICATIONS

The usefulness of a graphical analysis of findings that pertain to

accommodation and convergence obtained in a visual examination has been discussed fully in the literature.[6] Also, the use of the graphical method as a means of specifying the type and recording the results of orthoptics has been elucidated in publications.[5, 7] Consequently, the use of the graphical method for prescription of orthoptics with a stereoscope should be looked upon merely as as extension of the reports cited above.

Conventionally, the phoria positions of the eyes for different stimuli to accommodation are indicated on the graph by the symbol X.[6] Since the phoria measurement at 6 M. is made through the distance correction, the stimulus to accommodation is zero and the finding is plotted on the horizontal line corresponding to zero on the accommodation (vertical) scale. The prism scale at the bottom of the graph is used in plotting these findings.

The phoria measurement at 40 cms., when taken through the subjective correction, involves a 2.50 D. stimulus to accommodation and is plotted on the 2.50 D. horizontal line with reference to the normal demand line. The normal demand line connects the zero positions for the prism scales at 6 M. and 20 cms. Base-in findings for exophoria are plotted to the left of this line and base-out findings for esophoria to the right.

A line now can be drawn through the points representing the phoria positions. It will provide the expected phoria for any stimulus to accommodation.

The relation of the phoria line to the normal demand line provides a measure of the positive or negative fusional convergence that has to be used by a patient in order to have single binocular vision. Depending upon the criterion that is used to predict comfort for the patient, the fusional reserve that should be developed then can be computed from this value.

In prescribing orthoptic training with a stereoscope, it only is necessary to plot the phoria line for a patient on a graph indicating the different possible prismatic effects available in the instrument to be used. For example, in Figure 7 two phoria lines, GG' and HH', representing two different patients, are drawn on the graph. The one line indicates an excessive esophoria, and the other, exophoria. For both cases, it is seen that the phoria lines intersect some of the lines expressing the prismatic effects at different levels of stimulus to accommodation. First, we shall consider the case of esophoria. With this condition, almost invariably the amplitude of negative fusional convergence has to be increased. This is accomplished by requiring the patient to maintain clear vision while successively larger amounts of base-in prism or

smaller amounts of base-out prism are introduced before the eyes. By a study of Figure 7, it is seen that this effect with a stereoscope is produced by moving the target closer to the eyes.

The amount of base-in prismatic effect available from stereograms having separations of 20, 30, and 43 mms., can be determined from the figure. For example, the stereogram with a 30 mm. separation provides zero prismatic effect for a stimulus to accommodation of 1.75 D.; for a 5.0 D. stimulus the effect is 24△ base-in.

In using stereograms with fixed separations, the patients are instructed to trombone (i.e. move the target from the distance to the near position, or vice versa) while attempting to keep the targets clearly in focus. Obviously in esophoria, the patient always should attempt to keep the targets in focus with increases in the stimulus to accommodation as indicated by the arrows on line A, B, and C.

For exophoria, base-out prismatic effects are required: these are obtained by using targets with wide separations. For the example in Figure 7, it is seen that the stereogram with a separation of 70 mms.,

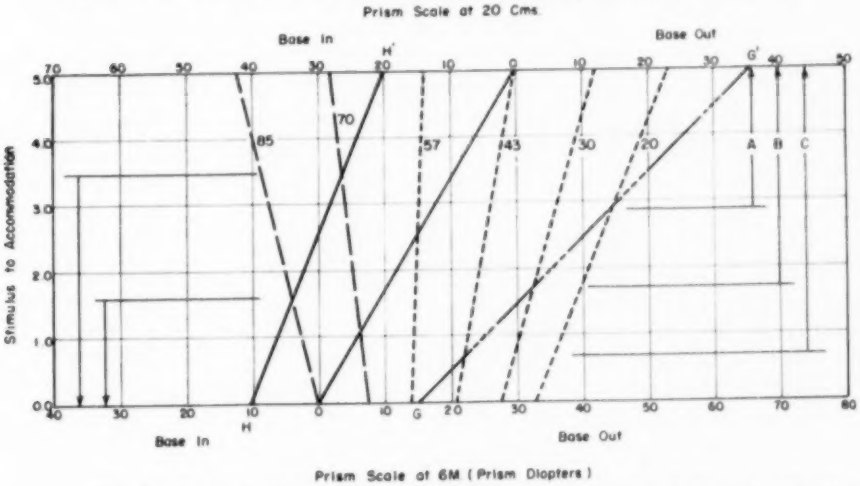

Fig. 7. An application of the graphical method to the prescription of orthoptic training in esophoria and exophoria. The lines for esophoria and exophoria are respectively GG' and HH'. The initial settings as well as the direction of movement of the stereograms for the esophoria are given by the lines A, B and C.

produces zero prismatic effect for a stimulus to accommodation of 3.50 D., and 18△ effective base-out for a zero stimulus. In this case, the patient should be instructed to move the target from the near to the

far position in order to reduce the stimulus to accommodation.

The method is applicable to any orthoptic instrument constructed on the principle of the stereoscope but is especially useful for those designs providing a change in the stimulus to accommodation by tromboning.

REFERENCES

1. Stoll, M. R., and Boeder, Paul: "The Stereoscope as a Training Instrument." Arch. Ophth. 39: 27-36, 1948.
2. Grupposo, S. S.: "Report on Renshaw Stereo-Disparator." Am. J. Optom. and Arch. Am. Acad. Optom. 26: 307-311, 1949.
3. Optometric Extension Program, Visual Training Papers, January through December, 1946.
4. Krimsky, E.: "The Stereoscope in Theory and Practice," also a "New Precision Type Stereoscope." Brit. J. Ophth. 21: 161-197, 1937.
5. Hofstetter, H. W.: "Orthoptics Specification by a Graphical Method." Am. J. Optom. and Arch. Am. Acad. Optom., 26: 439-444, 1949.
6. Fry, G. A.: "Fundamental Variables in the Relationship Between Accommodation and Convergence." Optom. Weekly, 34: 153-155, 183-185, 1943.
7. Zettel, J., Jr.: "A Graphical Method of Recording Prism Base Out Orthoptics." O-Eye-O, Quarterly Publication of the Beta Chapter of Epsilon Psi Epsilon O. S. U., 10: March, 1941.

BOOK NOTICE

THE OPHTHALMIC SERVICES UNDER THE NATIONAL HEALTH SERVICE ACTS, 1946-1952. G. H. Giles, Secretary, British Optical Association. Published by Hammond, Hammond & Company, Ltd., London. 503 pages. Cloth. £ 3.3.0.d. 1953.

In a country with socialized health care, laws and regulations relating to these matters become important, not only to the public, but to the practitioners who examine the patients and to the army of governmental employees who administer the program. This book reviews those laws and regulations that apply only to visual care and the optometrists and ophthalmologists who do this work. The author has played an important role in British optometric affairs during the critical period in which these changes have taken place and the book itself is a step-by-step review of the Acts and regulations (with their amendments) from the start, to those now in force. This is the body of law which, for all practical purposes, eliminated private practice in England, Scotland, Wales and North Ireland. It is a beautifully compiled and written piece of work about a very dreary business.

CAREL C. KOCH.

DIRECTIONAL SENSITIVITY OF THE PUPILLOMOTOR PHOTORECEPTORS*

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Light passing through a unit area near the center of the pupil is highly efficient in evoking a brightness sensation as compared to that passing through a unit area near the edge of the pupil if all other factors remain constant. This phenomenon, described in 1933 by Stiles and Crawford and verified since by a number of independent investigators, has become known as "the directional sensitivity of the retina" or as the "Stiles and Crawford effect." For a pupil 8 mm. in diameter, light entering near the edge is about 1/5 as effective as light entering near the center. The effect, which occurs in photopic (cone) vision, is essentially absent in scotopic (rod) vision. Although theoretical considerations are still a subject of some dispute, a recent theory attributed the effect to "light funneling" optical properties of the photoreceptor (O'Brien, 1951). According to this theory each visual cone has its photo-sensitive substance concentrated in the outer segment and the remainder of the photoreceptor (whose refractive index is greater than that of the surrounds) concentrates the light in the outer segment by successively reflecting the incident rays off its tapered sides. Rays striking the cone obliquely will, however, tend to be incident at angles less than the critical angle and consequently some of the light will be lost, the remainder being less effective in producing a visual effect.

In 1948 Spring and Stiles measured the size of the pupil by infrared photography while passing a light beam through different regions of the pupil of the nonphotographed mydriatic eye. Using a Maxwellian view which formed an image 0.5 mm. in diameter at the entrance pupil but subtended an angle of 52° at the retina, they found an increase from a diameter of 3.75 mm. for central entry to 4.1 mm. for entry at 3 mm. nasal and 4.0 mm. for entry at 3 mm. temporal. In the light of current

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We gratefully acknowledge the financial assistance of Theta Chapter Omega Epsilon Phi Fraternity, the kind cooperation of Drs. John Faris, Carol Pratt and James I. Sears, and the patient consideration of our subjects. Keith Wilson, Michael Coffey and Ray Gardner, in carrying out this investigation.
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knowledge and concepts in vision such data may be interpreted in at least three different ways:

a. The pupillomotor photoreceptors are rods and (like the visual rods) they have no appreciable directional sensitivity.

b. The pupillomotor photoreceptors are cones but (unlike the visual cones) they do not show a directional sensitivity.

c. The pupillometor photoreceptors are both rods and cones and (like the visual photoreceptors) these rods do not show a directional sensitivity while the cones do.

The present investigation was an attempt to evaluate the above interpretations of the data of Spring and Stiles. The experiments in some respects resembled those of Spring and Stiles but there were important differences introduced in order to satisfy the objectives of the study.

APPARATUS

The apparatus for this experiment is illustrated in Figure 1. In

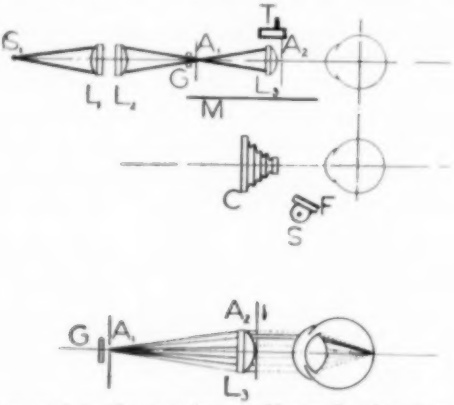

Fig. 1. Apparatus used in the experiment. Upper drawing is a top view of the apparatus. Lower figure is side view of the part of the apparatus immediately in front of the subject's right eye.

this figure the camera (C) (a Kodak Retina II-a with a + 12 D. trial lens placed in front of the objective) was mounted at approximately 8 cm. from the subject's left eye, the entrance pupil of which was first focused visually on a ground glass in the plane of the film. Kodak infra-red film was used and this was developed for 12 to 14 minutes at 68° F. in DK50. The subject's left eye was illuminated by the source (*S*) which supplied 50-foot candles of illuminance on the Wratten #70 filter (F), mounted in "B" glass. This source and filter were so

arranged that a small amount of visible (red) light fell continuously on the subject's left eye but in such a way that the source was not directly visible to the subject, during the experiment.

The subject's head was held firmly in position by a dental biting board mounted in an adjustable assembly* so that the head and eyes could be properly placed in position. This proper position was obtained when the subject's left eye was directly in front of the camera (C) and the subject's right eye was placed with its line of sight coinciding with the optical axes of the lenses (L_1), (L_2) and (L_3).

The scource (S_1) was mounted on the optic axis of these lenses. It was a 25-watt bayonet base Westinghouse lamp which was connected to a variable transformer which in turn was connected to the 110 volt AC line. Light from this source was collimated by the lens (L_1) and brought to a focus on the aperture (A_1) by the lens (L_2).

Immediately behind the aperture (A_1) was a piece of ground glass (G). The aperature (A_1) was a circular hole, 2 mm. in diameter, centered upon the axis of this optical system at the primary focal plane of the lens (L_3). Light from the aperture (A_1) was collimated by the lens (L_3) and after passing through the aperture (A_2) passed into the subject's right eye. A side view of this part of the apparatus is illustrated at the bottom of Figure 1. The aperture (A_2) was a circular 1.5 mm. hole mounted in a Gaertner Micrometer Slide (T) which had a 50 mm. range. This mounting was equipped with a micrometer screw which permitted the aperture (A_2) to be moved in a vertical plane across but immediately in front of the vertical meridian of the lens (L_3). Such a movement permitted a small pencil of light to pass through different parts of the vertical meridian of the subject's pupil, but the subject continued to see the test object clearly as long as the pencil of light was not obstructed by the iris. The position of the center of the pencil of light could be read from the micrometer scale with an accuracy of 0.001 mm. The image of the aperture (A_1) subtended an angle of less than 1° at the first nodal point of the subject's eye. Consequently central fixation of this image by the subject presumably permitted stimulation of the center of the rod free foveola (Polyak, 1941). The subject fixated this image in this way throughout these experiments, except during the dark controls.

The mask (M) was so placed that light from the source (S) was prevented from reaching the subject's right eye and in addition the light from the source (S_1) was prevented from reaching the subject's left eye

*We gratefully acknowledge the loan of this assembly by Drs. Merrill J. Allen and Glenn A. Fry of the School of Optometry of the Ohio State University.

or the camera. The lamp housing containing the source (S_1) was suitably covered with black cloth so that stray light in the room was kept to a minimum.

PROCEDURE

These experiments were carried out on three essentially emmetropic men selected from the student body of the College of Optometry of Pacific University. These subjects had 20/20 vision, blue irises, and no disease.

Before the beginning of each experiment one drop of a solution of 1% paradrine hydrobromide and 5% euphthalmine was placed in the conjunctival sac of the right eye of each subject. Ten minutes later a second drop was instilled. For one subject a third drop was instilled, one-half hour later. Approximately one hour after its instillation this solution produced a cycloplegia and mydriasis of the right eye. In each case the left eye was not apparently affected.

While waiting for the mydriasis to become complete the subject was aligned in the biting board apparatus. Once the mydriasis was complete the aperture (A_2) was moved until the lower edge of the pencil of light was coincident with the lower margin of the pupil and the subject adapted to the illuminance for 1.5 minutes, after which time a photograph (1/5 second exposure at f/2.0)* was taken. The aperture was moved up a specified interval and after another 1.5 minutes adaptation to this illuminance a second picture was made. This procedure was repeated until the upper edge of the pencil of light was coincident with the upper margin of the pupil, at which time the direction of travel of the aperture was reversed, the same procedure being followed until a second traverse of the pupil had been completed. After every nine pictures a control picture was taken. This consisted of a picture taken under identical conditions except that the pencil of light entering the right eye was occluded by blocking off aperture (A_2), in such a way that whatever stray light might be reaching the right eye was unaffected by the occlusion. After two traverses of the pupil the first phase of the experiment was completed and the subject took a fifteen-minute rest period.

For the second part of the experiment the subject was placed in the biting board apparatus in the same way as in the first part. The aperture (A_2) was placed in such a way that the pencil of light passed through the center of the entrance pupil of the subject's right eye.

*This value represents the f number of the camera without the +12.00 D. trial lens and not the effective value of the system with this additional lens in place.

Measurements were made of the magnitude of the consensual photopupillary reflex as a function of illuminance of the pencil of light reaching the retina of the right eye. To do this the variable transformer was adjusted until the source (S_1) was sufficiently dim that the test object had a luminance of 100 ft.-L.* After adapting to the dark for fifteen minutes the subject adapted to the test object for three minutes after which time two photographs were taken in succession. The variable transformer was adjusted until the luminance of the test object had increased one-half log step, the subject was again given three minutes to adapt to this level and two more photographs were made. The same procedure was followed in half log steps until the test object was at its maximum luminance (1.5×10^5 ft.-L).* Again every tenth photograph was a dark control.

The data were analyzed by projecting each photographic negative on a ground glass screen with a 35 mm. film strip projector adjusted to give exactly 10X magnification. The precise image size for the requisite magnification could be determined by using the horizontal distance between the outer margins of the iris as a reference. Measurement of this distance on the subject's naked eye was made with the Bausch & Lomb Interpupillometer.

VARIABILITY OF MEASUREMENTS

In order to get some idea of the variability of the measurements a series of 29 photographs were made in rapid succession following a fifteen-minute light adaptation to the test object at maximum luminance with the position of the aperture (A_2) such that the pencil of the stimulus light passed through the center of the pupil of the subject's right eye. The light adaptation period was preceded by fifteen minutes of dark adaptation. The subject continued to fixate the test object while the photographs were being made, the total duration of the photographing period being less than three minutes.

The results of this experiment for one observer (K.W.) are plotted in Figure 2. In the figure, the ordinates represent frequency and the abscissas are entrance pupil diameters in millimeters, arranged in classes with intervals of 0.20 mm. The frequency distribution curve has a range from 4.40 to 5.95 mm., a mean of 5.14 mm. and a standard deviation of $\pm$ 0.449 mm. Such a variation is fairly large with respect to the magnitude of the effect to be measured and emphasizes

*The values given here for luminance of the test object were obtained by a Luckiesh Taylor Brightness Meter placed against the lens L_3 when A_2 was removed. Consequently they give a measure of the retinal illuminance during the experiment only in relative units.

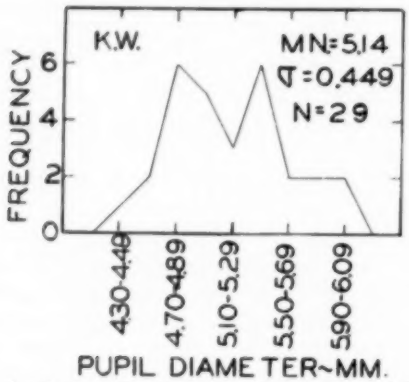

Fig. 2. Frequency distribution of twenty-nine measurements of the size of the pupil for central entry of the light bundle after fifteen-minute adaptation to the stimulus.

the difficulty of obtaining data which precisely fit a theoretical curve from a small number of measurements.

RESULTS

The results of the experiments on three subjects are given in Figures 3, 4 and 5. In each of these figures the top graph gives the data for the first phase of the experiment and the bottom graph gives the data for the second part of the experiment. In each the ordinates are the same, i.e. the difference in size of the measured entrance pupil diameter from that of the mean of entrance pupil diameters of the dark controls, in millimeters.

The bottom graph gives the magnitude of the consensual photopupillary reflex as a function of intensity. The abscissas are logarithms of retinal illuminance in relative units. For each subject the magnitude of the pupil constriction at the maximum illuminance was considerably smaller than maximum pupillary constriction and so the curves do not become asymptotic at the highest level as would be predicted if the retinal illuminance could have been increased indefinitely. (Moon and Spencer, 1944).

The upper graphs give the variation in magnitude of the consensual photopupillary reflex as a function of the region of the pupil through which the small (1.5 mm. in diameter) incident light bundle passed. The abscissas are distances (x) from the center of the point of entry of the light bundle to the center of the entrance pupil, in millimeters. In each case above the center is to the right and below the center to the left.

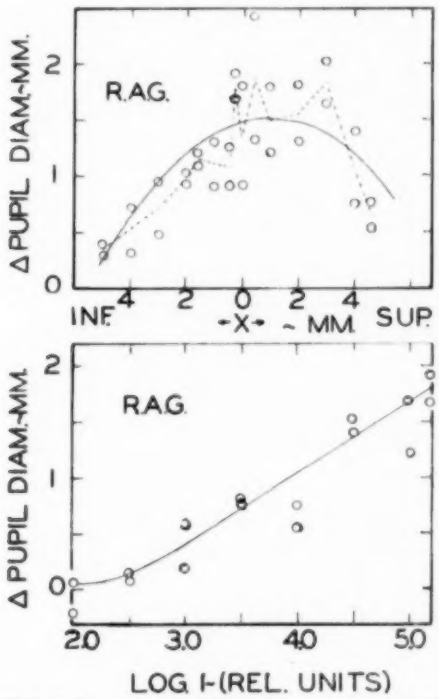

Fig. 3. Data for R.A.G. Upper Graph, change in pupil diameter with change in entry of the light bundle. Lower graph, change in pupil diameter with retinal illuminance central entry of light bundle. Theoretical curve in the upper graph is shifted so that the maximum coincides with the mean of the data for 1 mm. superior.

The dotted lines in each of the upper graphs connect the means of the two measursements (obtained from separate traverses of the pupil). The smooth solid curves are the curves theoretically predicted if the directional sensitivity of the foveal pupillomotor photoreceptors was similar to that of the foveal visual photoreceptors. These curves have been obtained in the following way. Moon and Spencer (1944) derived an empirical equation for the data of Stiles and Crawford (1933), which gives the relative visual effectiveness (n) as a function of the distance (x) from the center of the entrance pupil in millimeters:

$$n = 1 - 0.085\ x^2 + 0.002\ x^4.$$

For a given value of (x) the relative visual effectiveness was first calculated using this equation. The value of (n) so obtained was then multiplied by the retinal illuminance (in relative units) of the stimulus

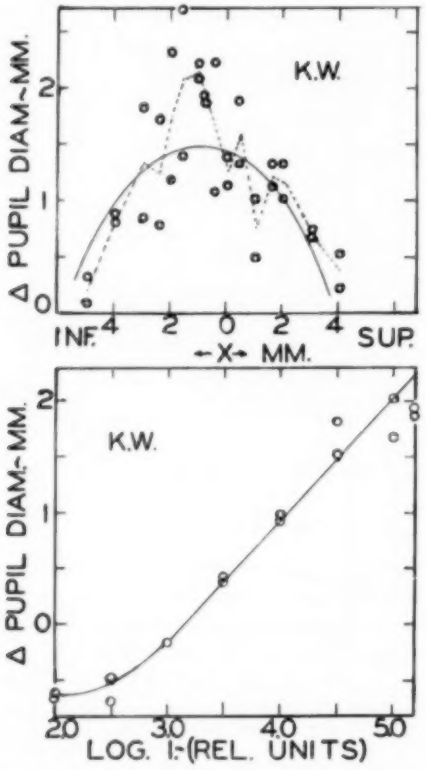

Fig. 4. Data for K.W. Upper Graph: change in pupil diameter with change in entry of the light bundle. Lower graph: change in pupil diameter with retinal illuminance central entry of light bundle. Theoretical curve in the upper graph shifted so that the maximum coincides with the mean of the data of figure 2 at 1 mm. inferior.

light, to obtain the theoretical retinal illuminance which (when directed through the center of the pupil) would give a brightness match with the stimulus light. The change in diameter of the entrance pupil that this theoretical retinal illuminance would produce (over the dark control) could then be read directly off the curves in the lower graphs of Figures 3, 4 and 5.

The theoretical curve for KW has been shifted so that the value at $x = 1$ mm. inferior (about which the data appear to be more or less symmetrical) coincides with the mean of the data of Figure 2, and the maximum of the curve is drawn at this point. Similarly the curve for

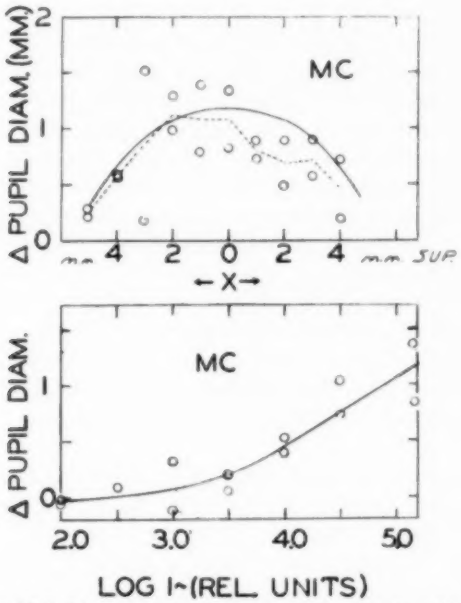

Fig. 5. Data for M.C. Upper Graph, change in pupil diameter with change in entry of the light bundle. Lower graph, change in pupil diameter with retinal illuminance central entry of light bundle.

RAG has been shifted so that the value at x = 1 mm. superior (about which point the data appear to be more or less symmetrical) coincides with the mean of the measurements at that point and the curve is drawn with its maximum at this point. The tendency for the curve of the Stiles and Crawford effect to have its maximum deviating slightly from the geometric center of the pupil occurred in some of the original Stiles-Crawford data and, according to Moon and Spencer (1944),

> ". . . These deviations are not experimental errors but are valid differences which depend on the eye and which may change gradually with time for the same eye . . . there appears to be no order in the changes . . ."

DISCUSSION

The data for all three observers appear to be in reasonably good accord with the predictions of the theory if allowance is made for the extremely wide variability of the measurements. As a matter of fact, the data for two of the subjects, KW and RAG, show, if any deviation at all from the theory, an even more marked directional sensitivity for the pupillomotor photoreceptors than for the visual photoreceptors. This is in sharp contrast with the data of Spring and Stiles (1948) which

showed a slight difference between the data for central and peripheral point of entry but not nearly as marked as predicted by the theoretical curve. In those experiments the stimulus subtended a wide visual angle and presumably spread over a large area of the retina. In such cases the stimulus can be considered as providing a "veiling glare" or "substitute for the stray light" within the eye (Fry and Alpern, 1953). Recent evidence seems to indicate that for conditions of 30 minutes dark adaptation and short flashes of light the photopupillary response is more closely related to the stray light within the eye than it is to the focal illuminance of the retina (Fry and Allen, 1951). If the same held true for conditions* of the present experiment, the data should have shown the same general trends as those of Spring and Stiles. This, however, did not prove to be the case and it therefore seems reasonable to conclude that under the conditions of the present experiments the focal illuminance of the retina plays an important part in the consensual photopupillary response.**

It is now possible to examine the various hypotheses suggested as explaining the data of Spring and Stiles. If the pupillomotor photoreceptors were rods which, like the visual rods, show no directional sensitivity then the magnitude of the consensual photopupillary reflex would be independent of (x) and, as a matter of fact, since the test object presumably stimulated only the rod free fovea, under the conditions of the present experiment no photopupillary reflex at all would have been elicited. (If the assumption can be made that stray light within the eye was negligible.) This therefore rejects the first hypothesis (a).

The second hypothesis (b), that the pupillomotor photoreceptors are cones but, unlike the visual cones, have no directional sensitivity, would predict that the consensual photopupillary response in the present experiments would be marked but independent of (x). In view of the data in Figures 3, 4 and 5 such an hypothesis appears untenable.

The third hypothesis (c), that the pupillomotor photoreceptors are

*Because of the procedure it was not possible to specify the state of adaptation of the observer in these experiments with any degree of precision. If the assumptions could be made that the observer's fixation remained stationary throughout the experimental period and that the stray light in the eye was negligible then the state of adaptation might be described as localized (foveal) light adaptation with gradually increasing peripheral dark adaptation. However, neither of these assumptions is free from question. In addition, no attempt was made to control the observer's state of adaptation prior to the onset of the experiment.

**The discrepancy between these two sets of data cannot be explained on the basis of the higher intensity of the stray light within the eye in the experiments of Spring and Stiles, since studies of the Stiles and Crawford effect would predict that decreasing the intensity of illuminance of the "veiling glare" in their experiments would only accentuate the discrepancy.

both rods and cones which act exactly as the visual photoreceptors, is in complete accord with all the data. The discrepancy between the data of Figures 3, 4 and 5 and those of Spring and Stiles can be explained on the basis of this hypothesis by the difference in the stimulus conditions in the two experiments. In the present experiment the test object was confined to a small (less than 1°) region of the centrally fixated field whereas the test object in the experiments of Spring and Stiles subtended an angle of 52°. According to Polyak (1941) it would be predicted that in the former case the retinal stimulus would be in a rod free region, whereas in the latter the stimulus would cover a region of the retina containing both rods and cones. In this latter case the directional sensitivity of the cone pupillomotor photoreceptors could be almost completely masked by the stimulation of the rod pupillomotor photoreceptors which have no directional sensitivity. The two sets of data in sum, therefore, constitute evidence supporting the idea that the pupillomotor photoreceptors are both rods and cones. Some evidence has been offered (de Launay, 1949) that pupillomotor photoreception is exclusively a cone activity, but the bulk of evidence fails to support this view (*cf.* critique of de Launay's paper by Knoll, 1949, and by Fry and Allen, 1951).

One other implication of the data of the present experiment should be pointed out. It is still a matter of conjecture as to whether a given photoreceptor serves both a visual and a pupillomotor function, or whether it is necessary to hypothesize separate photoreceptors to explain vision and pupillomotion. The data do not supply direct evidence to support either view, as would have been the case if the second and not the third hypothesis had been verified. However, the data can be completely explained by the assumption that a single photoreceptor can carry out both functions and clearly this is the more parsimonious hypothesis. At any rate, if two separate sets of photoreceptors *are* required to explain photopupillomotion and vision, it does not appear likely that they can be differentiated on the basis of their directional sensitivity.

SUMMARY

Infra-red photographic measurements of the consensual photopupillary response as a function of intensity permits prediction of the magnitude of the pupillary response which should be obtained if light would be sent through various regions of the mydriatic, nonphotographed pupil with the assumption that the directional sensitivity of the foveal pupillomotor photoreceptors is similar to that of the visual photoreceptors found by Stiles and Crawford. To check this assump-

tion, measurements were made on three emmetropic young men and, within the errors of measurement, the data were in good accord with theoretical predictions. Certain theoretical implications of the data have been pointed out.

REFERENCES

J. de Launay, (1949) J. Opt. Soc. Am., 39, 36-41.
G. A. Fry and M. J. Allen, (1951) WADC Technical Report 52-10, part 2.
G. A. Fry and M. Alpern, (1953) The effect of veiling glare upon the brightness of an object, J. Opt. Soc. Am. 43, 189.
J. N. Jean and B. O'Brien, (1949) J. Opt. Soc. Am., 37, 1057.
H. A. Knoll, (1949) J. Opt. Soc. Am., 39, 954.
P. Moon and D. E. Spencer, (1944) J. Opt. Soc. Am., 34, 319.
B. O'Brien, (1946) J. Opt. Soc. Am., 36, 369.
B. O'Brien, (1947) J. Opt. Soc. Am., 37, 275.
B. O'Brien, (1951) J. Opt. Soc. Am., 41, 882.
S. Polyak, (1941) The Retina, University of Chicago Press, Chicago, Ill.
K. H. Spring and W. S. Stiles, (1948) Br. Jour. Ophth., 32, 340.
W. S. Stiles and B. H. Crawford, (1933) Proc. Roz. Soc., B 112, 428.

BOOK NOTICE

PROCEEDINGS OF THE SECOND ANNUAL CONFERENCE ON OCCUPATIONAL VISION. Rutgers University, New Brunswick, New Jersey. Published by the Conference, Dr. Andrew F. Fischer, Treasurer, 162 West State Street, Trenton, New Jersey. 63 pages. Illustrated. Paper covers. $1.00, 1953.

This second annual "proceedings" has just been published. This volume contains the 13 original papers presented at the conference. Each of these papers is by a top specialist in his field and as all papers relate to occupational vision the book is sure to find ready acceptance and a welcome place in many libraries. The authors and their papers are:

Charles L. McCuen, "Vision for the Future"; W. H. Seymour, "Economic Value of Vision"; Robert Foster Ash, "Efficient Vision as a Productive Tool"; Dorothy Brinkley, "Savings in Production with a Sound Vision Program"; G. Luther Weibel, "Setting Up and Organizing an Occupational Vision Testing Program"; Roy F. Marks, "Economics of Visual Care"; C. R. Mullen, "Eye Injuries and Their Emergency Care"; Conrad Berens, "Incidence of Glaucoma Among Industrial Workers"; D. McKeen, "Eye Protection Practices in Light Industries"; S. W. Quisenberry, "Modern Use of Paint as an Aid to Safety and Efficiency"; W. Allphin, "The Cost of Seeing a Critical Industrial Task"; R. L. Zahour and J. J. Neidhart, "Modern Light as a Production Tool." and F. G. Foster, "Optical Aids for Better Seeing."

Dr. John R. Wittekind was General Conference Chairman and Dr. Andrew F. Fischer was Committee Treasurer. Copies of the volume should be ordered from Dr. Fischer at the address given above.

CAREL C. KOCH.

A THREE GENERATION PEDIGREE OF THE BLUE SCLEROTICS SYNDROME*

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INTRODUCTION

The patient, accompanied by her mother and son, sought aid for a mild conjunctivitis. Since all three had conspicuously blue scleras and the mother wore a hearing aid, suggesting the possibility of otosclerosis, it was decided to study the pedigree of this family with regard to the blue sclerotic syndrome.

Key[1], Bell[2], and Corboy[3] have historical reviews which yield some of the background for this section. Henzschel (1831) and Gescheidt (1832) were the first to describe blue-colored scleras associated with hereditary aniridia and microphthalmia. However, in 1788, Eckman had reported on three generations of hereditary brittle bones, but had not associated this condition with blue scleras. Spurway (1896) noted that some hereditary brittle bone patients had blue scleras. By 1900 Eddowes had proposed that fragile bones and blue sclerotics were part of a syndrome. Van der Hoeve and de Kleijn (1917), according to Brickley[4], were the first to note that otosclerosis, appearing typically in the second or third decade, becomes a third part of the syndrome. Cremin[5] believed that Adair-Dighton (1912) first noted the deafness aspect of the syndrome but since he reported only one of 14 affected persons as having otosclerosis, this aspect of the syndrome had not been firmly established by Adair-Dighton.

Lobstein (1825) had described fragile bones in a detailed report. In a review of Lobstein's disease, Ottley[6] described the symptoms and signs of the blue sclerotics syndrome as follows: (1) Fragile bones; (2) Peculiar conformation and structure of bones; (3) Laxity of ligaments; (4) Blue scleras; (5) Deafness and (6) Miscellaneous abnormalities of muscle reaction to electrical stimuli, of teeth, nails, hair, and of the vasomotor system.

Historically, the symptoms of the blue sclerotics syndrome were

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noted in about the order listed by Ottley[6]. Successively, at different periods and by various workers, this syndrome has been called Lobstein's disease, osteogenesis imperfecta congenita, osteopsathyrosis idiopathica, Spurway's syndrome, Eddowe's Syndrome, Adair-Dighton's syndrome, van der Hoeve's and de Kleijn's syndrome, and blue sclerotics syndrome. Key[1] named it hereditary hypoplasia of the mesoderm; Massler[7] — congenital mesodermal dysplasia; and Kemp, Wilson, Fish, and Stobie[8] named it hereditary mesodermal dystrophy.

In view of this multitude of synonyms, it is recommended that the name of the most prevalent symptom, namely blue sclerotics, designate the syndrome. Since the ectoderm gives origin to tooth enamel and since many predominantly mesodermal syndromes exist, a name implying restriction to the mesoderm is not desirable. To use the term congenital in its name does not truly represent some of the symptoms, such as deafness, which come on in adolescence or later.

Kemp and his associates[8] have traced a pedigree of this syndrome, extending through six generations, back to 1810 and designated it as the "H" pedigree. Since four females and one male, who were normal but acted as carriers, had one or more affected children or grandchildren, and since each of the remaining 25 cases had an affected parent, the inheritance was classified as dominant with about an 85 per cent penetrance of the trait gene. Such a trait is classed as irregular dominant. In simple dominant traits, there is a 100 per cent penetrance of the trait gene.

All of their cases and carriers can be derived from the types of mating depicted in Figure 1. Of the 23 pairs of chromosomes, the two

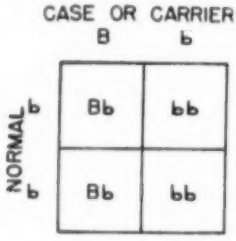


Fig. 1.
B = dominant gene for Blue Sclerotics Syndrome with about 85 per cent penetrance
b = recessive gene for normalcy.
Bb = affected person roughly 85 per cent of time.
Bb = carrier roughly 15 per cent of time.
bb = normal, non-carrier.
An affected person or carrier of the blue sclerotic syndrome mated to a normal non-carrier will have as offspring affected persons, carriers, or normals.

components of which are mirror images of each other, one pair has corresponding loci where the dominant gene "B" or the recessive gene "b" can be placed. The typical cell of a person, therefore, has two genes for this syndrome. Because only one of each pair of chromosomes is distributed to a sperm or ovum, the germ cells produced only have a single gene for the trait. The letter B above the "checkerboard" expresses its dominance about 85 per cent of the time and is the gene for the blue sclerotics syndrome. The letter b to its right is the recessive gene for normalcy.

The B is in one germ cell and the b in another. Similarly, the b and b genes to the left of the "checkerboard" denote normal, recessive genes, one to each germ cell of the mate.

The Bb and Bb within the left half of the "checkerboard" represents those genes possessed by one-half of the children, if chance operates. Since the B gene expresses its dominancy about 85 per cent of the time, about 85 per cent of children with the Bb genotype get the syndrome. Hence, the 15 per cent of children with the Bb genotype remain clinically normal as far as the blue sclerotics syndrome is concerned, but these latter children may act as carriers.

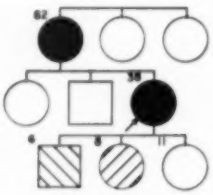
The bb and bb within the right half of the "checkerboard" stands for the normal genes possessed by the remaining half of the children on a basis of chance. These children are neither carriers nor individuals affected with the syndrome.

Kemp's group[8] claims that visual acuity was not affected specifically by the blue sclerotics syndrome, but that arcus juvenilis and premature arcus senilis were prevalent. Pingueculae were also common. However, these may have been acquired independently of the syndrome. Of their 25 cases, 17 were females. This agrees with Bell's[2] findings that 55 per cent of 448 cases were females, who are slightly better transmitters of the syndrome. The basis for this sex difference is not clear.

In the "H" pedigree about 60 per cent of the blue sclera patients had fragile bones and about 50 per cent had otosclerosis. Bell[2] found that about 45 per cent of those affected had all three major findings, but believed that about as many eventually become deaf as those that acquire fragile bones. If a person has blue sclera with a sound skeletal system, he is less likely to have otosclerosis.

THE PRESENT PEDIGREE

Our first subject was the 62 year old mother of the patient. See Figure 2. She is the affected person in generation I of this group. Her scleras were of a uniformly blue color. An arcus senilis and a pinguecula



(NUMBER TO LEFT OF SYMBOL DENOTES AGE)

○□-BLUE SCLEROTICS SYNDROME ABSENT
●-FEMALE, BLUE SCLERA, FRAGILE BONES, OTOSCLEROSIS
▨-FEMALE, BLUE SCLERA, FRAGILE BONES
▧-MALE, BLUE SCLERA ONLY
↗ PROPOSITUS, THE LEAD TO THE PEDIGREE

were present in each eye. She was 59 inches tall and weighed 139 pounds. Since infancy she has had "several" dislocations. Her first fracture, in November, 1952, resulted in a broken arm.

Deafness due to otosclerosis was first evident when she was 25 years old. The middle ear ossicles could no longer transmit the waves to the inner ear. Such patients, unless they have cochlear nerve deafness, hear well on the telephone and benefit from the use of a hearing aid.

Her visual acuity (Snellen) was 20/70 O.D. and 20/200 O.S. Right eye—A lens of +0.75 D. sphere, ⊃ +0.75 D. cylinder, axis 135 yielded 20/30 vision. Left eye—A lens of +2.00 D. sphere, ⊃ +1.50 D. cylinder, axis 90 gave 20/70 vision (cylinder not fully corrected). A +2.00 D. add for near allowed her to read Jaeger #2 O.D. and Jaeger #6 O.S.

The affected lady of generation I assured us that her two older sisters were not affected.

In generation II, the youngest woman and her brother were not affected. The oldest sib, the propositus for the pedigree, was the 38 year old mother of the children in generation III. She had blue scleras also. In her youth, she suffered from multiple fractures of her humeri, femurs and had a "few" dislocations. For the last ten years, tinnitus or a ringing sensation had been noted in the right ear. She has lost a moderate amount of hearing in that ear. She is 59 inches tall and weighs 120 pounds.

Her visual acuity was 20/20 O.D. and 20/40 O.S. Right eye, +1.00 D. cylinder axis 110 = 20/20. Left eye, —0.50 D. sphere ⊃ +1.00 D. cylinder axis 90 = 20/20.

The youngest member of generation III was an affected boy six years of age. He has not had any dislocations or fractures and has

normal hearing. At the time, he had only the blue sclera feature of the syndrome. His visual acuity was 20/20 O.U.

His eight year old sister was not available for study, but her mother assured us that she has blue scleras, has fractured a humerus and a leg bone and has had no dislocations. Her vision and hearing are believed to be normal.

A third child, an older girl, is normal according to the mother.

DISCUSSION

Blue sclerotics are the commonest feature of the syndrome, nearly every affected person displaying it at the time of birth. Fragile bones or dislocations may occur pre-natally, congenitally, or not until a few or several weeks or years after birth. Otosclerosis depends upon changes in the region of the middle ear bones and is noted most often after the age of 20, but may occur in adolescence.

Wright, Gernstetter, and Greenblatt[9], in a paper on the estrogen-androgen therapy of advancing the bone age of fragile bone patients, favor the view of Knaggs[10] who came to the conclusion that the blue color of the sclera is due to the greater translucency of a fibrous coat of normal thickness. Corboy[3] states that the case of blue sclerotics he studied was of normal thickness. Increased translucency alone was stressed by Bronson[11] to account for the normally thick blue sclera he had sectioned.

An older theory of von Ammon (1841) accounts for the blue color by postulating a thinner sclera. Until a larger number of such scleras are measured neither explanation can be considered as established. In any event, the China blue, slate blue or gray blue color results from the fact that the blood and pigment in the choroid and ciliary body seen through the sclera makes the latter appear blue. For the same reason superficial veins as seen through the translucent skin are blue. After studying 463 cases, Bell[2] found the blue varied from that of the normal newborn's sclera to that of a blackish blue.

Three eyes of congenital fragile bone patients were sectioned by Ruedemann[12]. These did not come from members of typical pedigrees and were complicated by juvenile glaucoma or some other condition. His microscopic studies, however, contribute to the reasons why a sclera appears blue. Ruedemann rightly claims clear sclerotics would be a more accurate title. He accounts for scleral transparency on the basis of a thinner fibrous tunic, a deficiency of collagenous fibers, fewer fibers in a loose network, or a possible increase of mucoid material. No deficiency of elastic fibers was noted, but an increase in the number of pre-collagenous reticular fibers was present.

Kemp and his co-authors[8] after a study of 25 cases do not believe that visual acuity is affected by this syndrome. They also claim that the adult has fewer fractures than occurred during childhood. Cod liver oil and vitamin D do not improve an affected person.

According to Cremin[5], a fenestration operation of the tympanic ring aids the hearing of the otosclerotic patient.

Our small group of cases showed the variable expressivity characteristic of the syndrome. A boy had only the blue sclera aspect of the syndrome. There is less than a 60 per cent chance of his acquiring fragile bones and there is less than a 50 per cent chance that otosclerosis will appear. His grandmother has had bone and joint symptoms and otosclerosis. His mother has had fragile bones, dislocations and has unilateral otosclerosis. His affected sister has brittle bones and has less than a 50 per cent chance of becoming deaf.

None of our patients was as disfigured and none had as many fractures as the extremely severe cases noted in textbooks: actually these extreme cases are in the minority

One should be aware, as Bell[2] has warned, that blue-colored scleras may be associated with hydrophthalmia, aniridia, and microphthalmia: or with myopia, keratoconus and megalocornea[12].

SUMMARY

Since blue sclerotics is the one aspect shared by nearly every case of the syndrome and since a multitude of synomyms exist for this same syndrome, the name blue sclerotics syndrome is favored.

The variable expressivity of the signs and symptoms has been outlined. Blue sclera is the commonest sign. Fragile bones and dislocations are next in line of frequency. Not far behind is otosclerosis yielding a middle ear, conductive-lack, type of deafness.

The blue scleras are typically congenital. Fragile bones can occur prenatally, but usually occur after birth. Otosclerosis, however, is an abiotrophy which becomes clinically apparent during adolescence or more often between 20 and 30.

In the present pedigree of the syndrome, there were four affected persons in three generations. There was a variability in the number of symptoms or signs found in the cases.

A dominant autosomal type of inheritance best explains the transmission in this pedigree. Although there is no evidence to date that irregular dominant genes are involved, this is still a possibility.

REFERENCES

1. Key, J. A.: Brittle Bones and Blue Sclera: Hereditary Hypoplasia of the Mesenchyme. Arch. Surg., 13:523-568, 1926.

2. Bell, J., Blue Sclerotics and Fragility of Bone. Treasury Human Inher., II, Part 3:269-324, 1928, Cambridge U. Press, London.
3. Corboy, P. M., Van der Hoeve's Syndrome: Four Occurrences in Three Generations of One Family, Am. J. Ophth., 24:57-60, 1941.
4. Brickley, D. W., Jr., Otosclerosis and Blue Scleras, Arch. Otolaryng., 46:230-236, 1947.
5. Cremin, M. D., A Case of Fragilitas Ossium, J. Laryng. and Otol., 66:92-94, 1952.
6. Ottley, C. M., Osteopsathyrosis (Lobstein's Disease): a Critical Review, Arch. Diseases Childhood, etc., 7:137-148, 1932.
7. Massler, M., Congenital Mesodermal Dysplasia, J. Dental Research, 28:673, 1949 (an abstract).
8. Kemp, F. H., Wilson, D. C., Fish, W. M., and Stobie, W., Hereditary Mesodermal Dystrophy, Brit. J. Social Med., 2:71-73, 1948.
9. Wright, P. B., Gernstetter, S. L., and Greenblatt, R. B., Therapeutic Acceleration of Bone Age in Osteogenesis Imperfecta, J. Bone and Joint Surg., 33A:939-946, 1951.
10. Knaggs, R. L., Osteogenesis Imperfecta, Brit. J. Surg., 11:737-759, 1924.
11. Bronson, E., On Fragilitas Ossium and Its Association with Blue Sclerotics and Otosclerosis, Edinburgh M. J., 18:240-281, 1917.
12. Ruedemann, A. D., Jr., Osteogenesis Imperfecta Congenita and Blue Sclerotics (Clinicopathologic Study), Arch. Ophthal., 49:6-16, 1953.

BOOK NOTICES

MANUAL OF OCULAR TESTS AND REQUIREMENTS. Third edition. Council of Education and Professional Guidance, American Optometric Association. Published by the Association, Wilmac Building, Minneapolis 2, Minnesota. 79 pages. Board covers. $3.50. 1953.

This monograph deals with the required visual qualifications for candidates for federal civic service positions and for the several branches of the armed services. In additional to reviewing the required visual qualifications it also provides the reader with a review of the examination and refraction procedures expected on the part of the optometrist and the method of reporting the findings.

This material was originally compiled from many sources by Dr. H. Ward Ewalt, then chairman of the Council of Education and Professional Guidance of the American Optometric Association. It has since been kept up to date by the committee and the current edition is the third complete revision. This monograph is a very handy reference book and should be available in every optometric office.

TERRY JUDITH PARKINS

THE ELECTRICAL RESPONSES OF THE EYE*

PART III. THE ELECTRORETINOGRAM

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The electroretinogram (ERG) is the overall pattern of potential elicited by stimulation of the retina. It may be recorded by placing one electrode on the cornea and the other on the optic nerve. More conventionally, only the posterior half of the eye is used, the standard leads being attached to the inner and outer surfaces of the retina. Other leads may be used for the study of more specific problems (Granit, 1947).

Because of the complexity of the response of the vertebrate retina it is convenient to begin by examining the electric potentials which originate in the retina of simpler eyes. Hartline and Graham (1932) recorded the electroretinogram of Limulus. This response is produced by illumination after about 0.02 sec. and precedes the optic nerve discharge. The latent period is shortened and the potential increased by increasing the stimulus strength. The maximum potential developed by this eye is approximately 20 mv. There is no evidence of an off effect either in the ERG or the optic nerve discharge. These investigators also found, in recording the optic nerve discharge of Limulus, that the individual impulses are superimposed upon a slow potential. The closer the electrode was placed to the exit of the nerve from the eye, the larger this potential was found to be. A similar slow potential was found in the optic nerve of the cephalopod, Loligo, (Therman, 1940) and the water beetle, Dytiscus, (Bernhard, 1942). When the preparation is crushed, no trace of this potential can be recorded. Further, the latent period increases when the leads are placed farther from the eye. All this evidence seems to indicate that the retinal disturbance is somehow transmitted to the optic nerve (Granit, 1947). The disturbance probably originates in the receptor elements themselves as an electrotonic potential which spreads to the optic nerve (Bernhard, Granit and Skoglund, 1942). The monophasic electroretinogram of Dytiscus has

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Part IV, Some Sensory and Clinical Correlates, will appear in the December issue.

turned out, after further analysis (Bernhard, 1942) to be made up of two components, a slow monophasic S-component and a more rapid monophasic R-component. Of these, the latter alone seems to be responsible for the optic nerve discharge. The S-component, first believed to originate in the pigment layer (as a result of pigment cell migration) has later been shown to originate in the receptor (Granit, 1933; Therman, 1940).

The vertebrate ERG is a complex curve (Figure 15). Brucke and

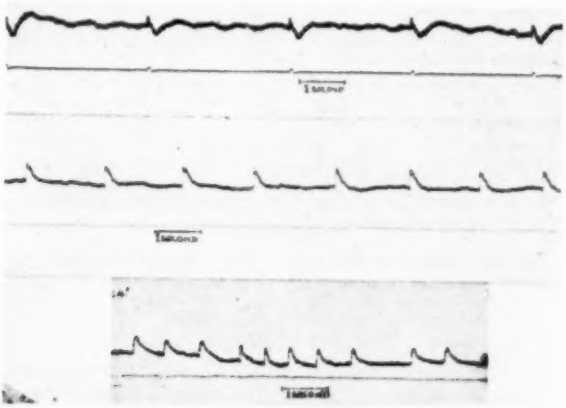

Fig. 15. Top: Record from normal guinea pig. Middle: Record from normal pigeon. Bottom: Record from normal rabbit. Before the records were taken the animals had been exposed to normal room lighting. Stimulus was about ten times threshold. After Waters, 1950.

Garten (1907) and later Einthoven and Jolly (1908) obtained from the whole eyeball a curve which had all the components of the ERG known today. There is an initial sharp negative variation (a-wave) followed by a rapid positive rise and decline (b-wave) and a later gradual rise and fall (c-wave). When the light is off, there is a small fluctuation superimposed on the c-wave. This off effect is the d-wave. These waves are characteristic of all vertebrate eyes though they have more significance in some than in others. The ERG must be differentiated from the resting potential which is of the order of 6 mv. and independent of illumination. Kuhne and Steiner as early as 1881 had pointed out that the resting potential of the excised eye steadily diminishes until it finally becomes negative while the retinal response to illumination did not change in sign. The fact that the light response was generally described in the older literature as an increase in the

normal resting potential has probably been responsible for a good deal of confusion in discussion of the ERG.

Following a suggestion by Piper (1911) that there are two types of retina in terms of their response to light, Granit (1935) extended these studies and identified them as I-retinas and E-retinas. The characteristics of each are given in Table IV.

TABLE IV

I-RETINAS AND E-RETINAS

Characteristics of I-Retinas or I-ERGs	*Characteristics of E-Retinas or E-ERGs*
1. A relatively large and brisk off effect, due to renewed P II activity.	1. A small and slow off effect.
2. Supernormal negative a-waves ("notches") elicited by flashes falling on the eye during the off effect.	2. A subnormal positive b-wave elicited by a flash falling on the eye during the off effect (such waves are not preceded by a negative "notch").
3. The reaction to fast intermittent stimulation: positive off effects, elicited by the dark intervals, cut short by the negative a-waves caused by the flashes.	3. The reaction to intermittent stimulation: repeated subnormal b-waves elicited by the flashes.
4. The fact that, when the type of reaction changes as a result of light adaptation, the change is more marked at "off" than at "on," tending to make the features summarized above more obvious in light- than in dark-adaptation.	4. The fact that, when the type of reaction changes after light-adaptation, the change is more marked at "on" than at "off."
5. A rather high fusion frequency in the photopic state as the negative "notches" or a-waves, which play such an important part in the reaction to intermittent light, coincide with volleys of (pre-excitatory) inhibition interrupting the rebound of excitation at "off."	5. A rather low fusion frequency in the photopic state. Since the subnormal b-waves coincide with volleys of impulses in the nerve, this type of retina may be said to respond to flicker primarily with volleys of excitation.

After Granit, 1935.

In order to fit these results into a fame of reference, it has been proposed that the E-type be identified with a rod dominated retina and the I-type with a cone dominant retina. Such a scheme becomes intelligible only if the cone is regarded as the more primitive type of photoreceptor. (c.f. Walls, 1942; Detwiler, 1943.) The evidence for this is that the eyes of animals having mixed retinas react like E when dark adapted and like I when light adapted. In the almost pure cone retina of the pigeon, the I-character is permanent whereas in the cat retina, which is dominated by rods, the E-character is permanent. As Granit points out, however, the electroretinogram reflects the responses of the retinal receptor mechanisms as an *average* and, consequently, the distinction based on E- and I-types must be regarded as only a first approximation. In terms

of rod or cone *dominance* in a given animal, it would seem that the data can be made to fit into the general scheme of the duplicity theory.

It can be shown that the retinas of animals in which cones predominate tend to give the E-type response while those in which rods predominate, the I-type ERG is manifested. The full implications of such a division will, however, have tc await further research on a greater variety of animals. In particular, we will need to know much more about the significance of the ERG as a whole and its components: it is this type of evidence which will now be considered.

In attempting to understand the significance of the ERG we must first consider whether it is the sum of simpler components. If such is the case, the next step is to identify the various components with specific histologic elements of the neuroretina. This is no simple task. The ERG is a complex curve, and the retina a highly integrated network of neurons. These, in addition to the fact that present techniques do not allow the recording of electrical changes from any but ganglion cells, have continually hampered progress. What little we do know is based to a great extent upon the beautiful and painstaking research of Granit and his coworkers at the Caroline Institute in Stockholm.

The first problem which arises in ERG analysis is the isolation of its components. The fact that the ERG was not a simple curve but a composite effect was realized by Einthoven and Jolly (1908). Their method of analysis is presented in Figure 16. Piper (1911), Waller

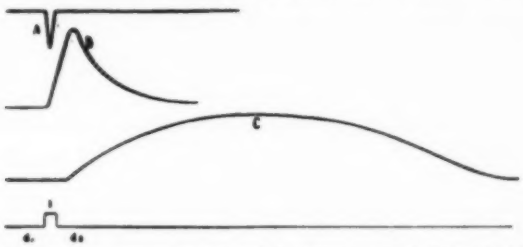

Fig. 16. A diagrammatic representation of Einthoven and Jolly's (1908) analysis of the retinal response. The three curves (representing three hypothetical "substances") sum in their proper time relations to give a normal action potential. (From *Quar. J. Exper. Physiol.*)

(1900) and Chaffee, Bovie and Hampson (1923) each had their own ideas or modifications on the analysis of the components of the ERG. It was not until 1932, however, that a reliable system of analysis, based on physiologic evidence, was forthcoming. Granit, (1932, 1933) and his coworkers observed that it was possible to isolate certain components by the use of various drugs. For example, the three components

which are now believed to be responsible for the composite ERG were labelled according to their differing disappearance under ether narcosis. Thus, process I (P-I) is the first to disappear when a cat inhales ether, P-II and P-III subsequently vanishing from the record in that order. As regards the nature of the components themselves, it can be seen from Figure 17, that P-I accounts for the c-wave, P-II for the b-wave and

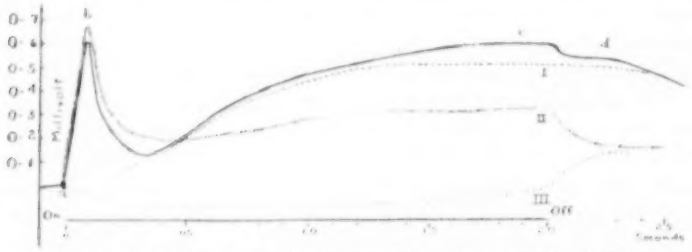

Fig. 17. Analysis of E electroretinogram. After Granit, 1947.

partially the d-wave whereas P-III, the only negative component, is responsible for the initial a-wave and, in conjunction with P-II, for the d-wave. The d-wave off effect is therefore seen to be an interference phenomenon.

It is difficult to discuss the characteristics of these individual components except within the frame of reference of the I- and E-type of ERG responses. For example, P-III is very prominent in the I-type and considerably reduced in the E-type. Similarly, and partly on account of this, the off effect is more prominent in the I- than the E-type. The effect of light and dark adaptation are also best envisioned in terms of the I and E differentiation while the latter may, as we have seen, be fitted into a scheme which considers relative rod and cone dominance. It should not be assumed, however, that such schemes are by any means clear cut and valid for all cases. To take the above illustration as an example, although the facts indicate that P-III seems associated with the cone pathways, it is increased by light adaptation and there is no conclusive evidence that this potential originates in the cones. It has, in fact, been suggested that the amacrine cells are involved (Graham and Granit, 1931). Amacrine cells, associated with the cone rather than the rod system, are, therefore, not ruled out of the duplicity scheme providing, as Granit has emphasized, that the duplicity theory be extended to the rod and cone *systems* rather than to the photoreceptors exclusively. Further, P-III is associated with inhibition and is probably not related to optic nerve discharge at all. This means that our views on the role played by the cone system in vision may need radical revision. Finally,

its response to alcohol indicates that P-III may be made up of two separate components only one of which originates in the receptors. It is clear, however, that P-III is definitely associated with inhibition and since the a-wave precedes the b-wave, it may be regarded as a mechanism which wipes the slate clean before subsequent discharges (Figure 18). The foregoing discussion of P-III will serve to emphasize

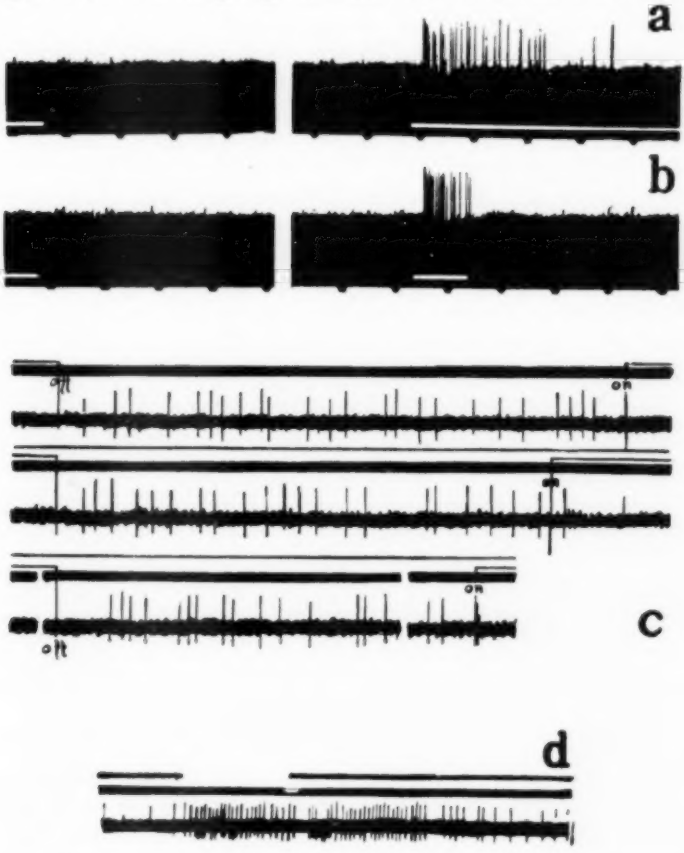

Fig. 18. Inhibition of the off-response by re-illumination. (a) Normal response of off-fibre of frog. (b) response inhibited by re-illumination (Hartline, 1940, *J. Opt. Soc. Amer.*, 30); (c) inhibition of response in off-fibre of rat by re-illumination. Intensity of stimulus: 2.400 m.c. (Garnit, 1941, *Acta Physiol. Scand.*, 2); (d) effect of re-illumination on on-off-element of cat. Note brief temporary inhibition followed by re-excitation. Intensity of stimulus: 0·82 m.c. Time marking of all records: 1/5 sec. After Granit, 1947.

some of the difficulties associated with ERG analysis.

Similar complications arise in attempting to describe the components P-I and P-II. The first of these is also unrelated to the optic nerve discharge. When the eye of a frog or cat which contains both rods and cones is light adapted, P-I disappears; this does not occur in the pure cone eyes of the turtle (Meservey and Chaffee, 1927) or tortoise (Bernhard, 1941). This suggests that the rods play some part in the elaboration of P-I, particularly since it seems to have the same general sensitivity to different wave lengths (Granit and Munsterhjelm, 1937). Probably P-I acts to sensitize the P-II component especially in the transition from light to dark adaptation. The P-II component is highly sensitive to oxygen lack (Figure 19), which provides a useful method of isolating the P-I plus P-III responses. The P-II component, it will be recalled, is responsible for the b-wave of the ERG. It is the only component directly associated with the optic nerve discharge and, like it, decreases with light adaptation and continued illumination. The b-wave, however, exhibits some erratic behavior. At low intensities for example, it rises in two or more steps (Granit and Munsterhjelm, 1937).

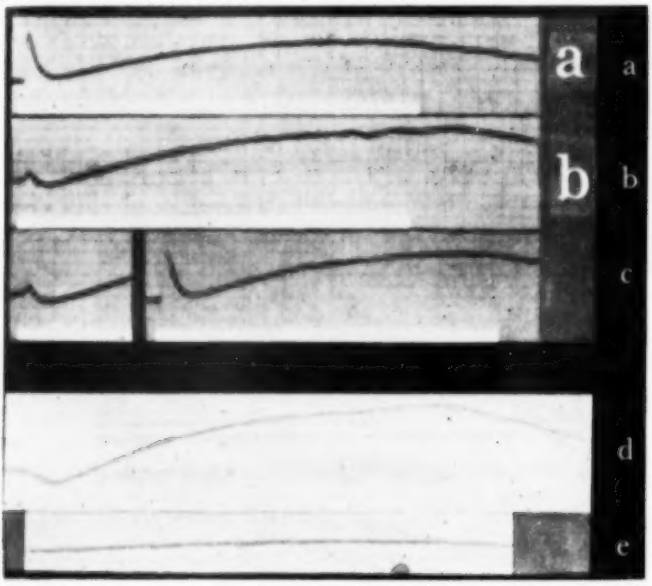

Fig. 19. The effect of retinal asphyxia on the cat electroretinogram. (a) Normal record. (b) after occlusion of the carotids; (c) recovery; (d) and (e) effect of asphyxia from another experiment. Stimulus in (d) was 100 times that in (e). (Granit, 1933, *J. Physiol.*, 77.)

Further, the off component of P-II is increased by epinephrine at the same time that the b-wave is depressed. This must mean that the P-II component represents the sum total of a number of processes with different latent periods and rates of appearance thus producing different amounts of positive potential (Granit, 1947). For example, one of the causes of multiple b-waves may be the difference in rod and cone responses since the waves may be separated by using long and short wave lengths (Granit and Munsterhjelm, 1937). Finally, it is unlikely that P-II has its origin in the ganglion cells because it is unaffected by antidromic stimulation. Granit (1947) believes that P-II originates in the neural pathways between the receptors and the ganglion cells and that it is the electrical manifestation of excitation in these pathways. Bartley (1939) has gone so far as to locate it in the bipolar cells.

What conclusions can be reached on the basis of the evidence just discussed? This is a problem which is somewhat more complex than superficial examination would reveal. It involves first settling the question of whether the electrical manifestations are the causal factors of excitation (and inhibition) or merely a phenomenon concomitant with the chemical disturbances. Granit (1947) believes that the evidence suggests a reasonable electrical theory although he admits other theories are possible. Such a theory (here presented in a highly simplified form) would involve the depolarization of the fiber attached to the photoreceptor. This depolarization would be caused by the electrotonic potential which is in turn a function of the photochemical changes in the photoreceptor. This electrotonic potential, at least for the rods, may tentatively be identified with P-I. The wave of depolarization is transmitted to the bipolar cell which in turn activates the optic nerve discharge. This process may tentatively be identified with P-II* Finally, a receptor potential associated with the cones for inhibition may be tentatively identified with P-III. It should be emphasized that

*Consideration should also be given to the suggestion by Fry and Bartley (1935) that the b-wave of the ERG is determined by the nonfocal (i.e. stray light) within the eye. Recent evidence published by Boynton (Ph.D. thesis, Brown University, 1952) supports such a viewpoint but, unfortunately, the present writer did not have Boynton's paper available to him. It might also be mentioned in this connection that according to a recent paper by Fry and Alpern (1953) the stray light may also be responsible for the so-called *a*-adaptation "spread" discovered by Shouten and Ornstein in 1939. It would appear to the present writer that, considering the extreme sensitivity of the retina, the effect of minute amounts of radiant energy (amounts which might easily have been disregarded) could be expected to produce significant changes in the electrical response as well as result in perceptible changes in the visual field. Such stray light effects could, of course, be significant only at scotopic illumination levels. Nonetheless, one must admit that the satisfactory recognition and measurement of such stray light effects impose considerable technical problems. It should be interesting to await further developments in this area.

this is more or less speculative. Further elaboration of such a theory is beyond the scope of this paper.

In a recent paper, Waters (1950) surveys various techniques of electroretinography of experimental animals and presents some details of the apparatus involved. He recommends a directly coupled amplifier for light stimulation lasting one second or longer. If the flashes last 0.1 second or less, a condenser coupling may be used which greatly simplifies construction. When the amplifier is used with a cathode ray tube the gain should be at least 10^5. In order to prevent pick up of outside interference with such sensitive apparatus, it is necessary to provide adequate screening. Waters suggests a cage built of expanded metal fastened to a wooden frame and grounded to a water main. The cage houses all of the equipment. The details of the amplifier circuit, after Waters, are shown in Figure 20. The light stimulator involves a 6 V bulb

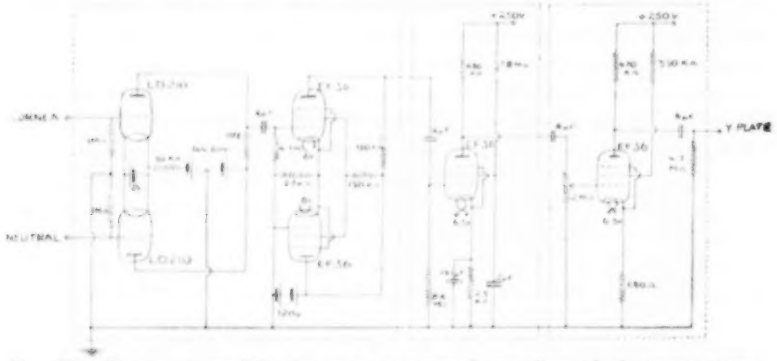

Fig. 20. Circuit of amplifier for the experimental recording of electroretinogram. Mains operated power units for the last two stages and for the cathode ray tube are not shown. After Waters, 1950.

fitted into an adapted gunsight. The light is focused upon a sliding neutral density optical wedge and a shutter giving short flashes. Provision for the insertion of colored filters is made and a photo-electric cell is introduced to signal the light flashes to the second beam of the oscilloscope. For electrodes, U-tubes filled with Ringer's solution and having a silver rod coated with silver chloride dipping into one arm were used. A cotton wick soaked in the solution and emerging from the other end of the tube makes the contact with the eye. The electrodes may be modified to be inserted into contact lenses, which are usually used for human eyes. (Figure 21.)

Although, as Waters points out, electroretinography affords the only objective method of determining retinal function in animals it

Fig. 21. Patient with contact lens electrode in place, as used in the recording of the electroretinogram. From Jacobson and Berens, 1951.

does not tell us what the animal actually sees. He cites an experiment by Granit (1945) which demonstrated hue-discriminating elements in the eye of the cat which is almost certainly color blind. Thus Waters writes:

> "The retina is only one link in the visual system so that training experiments alone can provide information as to what the animal sees, since 'seeing' involves not only the production of impulses in the optic nerve, but also an interpretation of these impulses by the animal's higher centers."

Concerning human electroretinography, Adrian (1944) showed that there are two different types of response to colored lights, photopic and scotopic. He finds the diphasic photopic curve most marked in response to red light and absent with blue light stimulation. The scotopic response is monophasic, absent in light adaptation and greatly increased in amplitude in dark adaptation. Light of intermediate colors produces a mixture of response curves. Other workers have confirmed these results.

Karpe of Sweden has been the most prolific worker in the field of clinical retinography. He studied the effects of air, mydriatics, refractive errors and ocular and lid movements upon the ERG. He has established what he considers normal limits (e.g., a b-wave of 0.23-0.51 mv.) and tentatively identified four abnormal types. The height of the b-wave was used as a criterion. A subnormal type (b-wave less than 0.18 mv.) was obtained in cases of high myopia, detached retina,

edematous retina, hypertensive retinopathy, retinitis pigmentosa, glaucoma, cataract and embolism of the central retinal artery.

An ERG, showing no response, was found in myopia associated with detached retina, periphlebitis of the retina with secondary atrophy of the optic nerve, retinitis pigmentosa and in an eye blind due to cataract. A supernormal ERG (b-wave more than 0.55 mv.) was found in thrombosis of the central retinal vein, papillitis and acute optic neuritis. Many diseases, however, were found to give an ERG within normal limits. It must be concluded that the electroretinographic methods are not yet firmly enough established to serve as an adequate diagnostic tool although they yield supplementary information, particularly in cases of intra-ocular foreign bodies and retinal detachment. A good survey of this general area of investigation is reported by Jacobson and Berens (1951).*

*Part IV, Some Sensory and Clinical Correlates, will appear in the December issue.

INSTRUMENT REVIEW

ILLUMINATOR FOR AO 590 PHOROPTOR SCALES. American Optical Company, Southbridge, Massachusetts.

An illuminator attachment is now available for the AO 590 phoroptor. This illuminates the scales, making it easier to operate in darkened offices. It does not interfere with phoroptor controls and can be installed in AO 590 phoroptors now in use or be ordered as factory-installed equipment on new units, from American Optical Company.

The illuminator was developed from an original model devised by D. B. Howard, O.D., of Perth Amboy, New Jersey. Dr. Howard's model proved functionally effective, and further design development resulted in a unit which fits flush against either side of the phoroptor clearly illuminating cylinder axis, sphere power, cylinder power, and auxiliary dial scales.

Each of the two illuminator units contains two light bulbs. The cord is clipped closely to the instrument arm and plugs into any 6 volt transformer.

ROBERT E. BANNON.

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DIVERGENT VIEWPOINTS AT THE NATIONAL INTERPROFESSIONAL COMMITTEE ON EYE CARE MEETING

Since the formation of the National Interprofessional Committee on Eye Care, your editor has been one of optometry's representatives on this committee. The present editorial is by way of a report on the activities of the committee. The eighth regular meeting of the committee was held at Chicago, Illinois, October 11, 1953. Chairman Culler[1] opened the meeting with the following remarks:

"This Committee was formed at the instigation of the Joint Committee on Visual Physiology and Optics to provide a common meeting

[1]Arthur M. Culler, M.D. Ophthalmologist. Chairman, Department of Ophthalmology, Medical School, The Ohio State University, Columbus, Ohio.

ground or forum. The friendships formed here will gradually allow a more frank and open presentation of various interests, but we must realize that while we are all dedicated to the care of the nation's eyes and the good of the patient, we are each here representing a group with special interests. We must be idealists here. We may criticize the actions of another group particularly when we have specific suggestions to the representatives of that group which may lead to more amicable relations, but we must face the fact that under present codes we may leave a conference with irreconcilable differences between the bodies we represent and we must keep these conferences open not only to representatives of all interested groups but to invited guests in various related fields. As Prangen[2] used to say, 'the more the merrier.'

"The chairman has carried several requests to the parent committees for ophthalmology and wishes to report the following actions:

"1. The Joint Committee approves and will undertake to encourage the exchange of selected lecturers among the three groups, opthalmology, optometry, and opticianry on national, State and local levels.

"2. The matter of supervision of orthoptic technicians was brought to the attention of the American Orthoptic Council and an open meeting for the discussion of this matter and the entire field of orthoptics was held on Friday, October 8, 1953. It is the sentiment of the Joint Committee that this comparatively new and important field should be developed jointly by ophthalmologists and optometrists avoiding rivalry from the beginning.

"3. A subcommittee was appointed to prepare recommendations for improving the early recognition of glaucoma and suggestions should be forthcoming soon.

"4. A subcommittee was appointed to consider standards for qualified opticians.

"5. Our request for support of activities in the organization and providing of information to state interprofessional committees was referred to the Council of the American Academy of Ophthalmology and Otolaryngology for action."

The Committee then considered and acted on a number of matters which, when concluded, will be turned over to the parent bodies for their consideration. However, as Culler had stated, there were serious differences between the groups as the meeting progressed. The representatives of each group naturally acted as a unit in considering the questions before the committee.

[2]Avery DeH. Prangen, M.D. Ophthalmologist, Section on Ophthalmology, Mayo Clinic, Rochester, Minnesota. Chairman Emeritus, National Interprofessional Committee on Eye Care.

During 1953 it has been evident to those of us working as the National Interprofessional Committee on Eye Care that this program to improve professional relationships has encountered a series of proposals by participating groups which may make the future of the committee problematical.

Each of these proposals is supported militantly. Each has some basis for the support it receives. Yet in each proposal the opponents can and do present viewpoints which should not and cannot be ignored In other words, problems are present, which involve two or more groups and do not lend themselves to easy solution. What are these major problems that were touched on during the meeting?

* * * *

First, ophthalmology through its parent bodies has proposed that optometry entirely withdraw from the Federal Social Security—Aid-to-the-Blind program. Ophthalmology contends that this federal program deals almost entirely with pathology or eye injury, these being the province of the ophthalmologist only. It further contends that optometry got into the program through an unusual legislative quirk and that optometry, to prove its good intentions in the family of professions, should withdraw from the program rather than take advantage of the situation. This position of ophthalmology is strengthened because the A.O.A. is originally on record opposing the aforementioned legislation in the form in which it was adopted, and at that time, 1950, the American Academy of Optometry advised its members to refrain from filling out the medical form then in use relating to this work.

On the other hand optometry contends today that *time* and a somewhat revised program has altered the situation. When the legislation in question was first passed the federal Social Security Agency and its State agencies required the examining doctor to fill out a form called the "long-form." This required a complete diagnosis on the part of the examiner and also required a statement from him that everything medically and surgically had been done for the applicant which could be done to improve his vision. Obviously this type of a report could not readily be made by an optometrist. The federal Social Security Agency, to make the original legislation workable, later authorized the use of a special "optometrist-form," or "short-form," to be used by those applicants wishing to have an examination by an optometrist. Many State social security offices provide these forms. This short form only calls for such information as can be properly supplied by the optometrist within the framework of the optometry law under which he is licensed. As a matter of practice, applicants visiting an optometrist

with such an application form are frequently reexamined by an ophthalmologist before the records are completed and the application is acted upon by the agency. In other words, in the several years which have passed between the enactment of the legislation and the present time, the agency has re-orientated itself to meet the required conditions of the federal law. The agency has set up a program giving all applicants a free choice of doctor. A number of State agencies have indicated satisfaction with this arrangement and the work done by optometrists. Optometry admits that the plan as now constituted is, at times, a little cumbersome, but it contends that in receiving a dual examination the applicants are better served because optometric techniques with all sorts of sub-normal vision aids are frequently introduced by the optometrist to improve their vision.

Optometrists further point out that the geographical distribution of their practitioners is such that applicants almost anywhere can readily reach their offices for preliminary screening, while ophthalmologists are usually found only in the larger urban centers.

In addition, optometrists point out that all State laws have now been amended to authorize optometric participation in this federal program and that this is a proper and fair procedure, since it provides for free choice of doctor by the applicant.

Optometrists finally contend that under this Aid-to-the-Blind program they are making only the optometric tests usually employed in their examination and refractive work and they are in no way invading ophthalmological practice when they do these examinations and refractions in this way on this special group of applicants.

* * * *

The second major problem is presented by optometry. Its official economic body, the American Optometric Association, has proposed that the National Interprofessional Committee on Eye Care be reorganized to include only two professional groups, the ophthalmologists and the optometrists. This proposal would eliminate opticianry from its present places on the committee and would bring opticians into consultation with other members only on those questions directly relating to them, or their work. The A.O.A. resolution dealing with this proposal is now in the hands of ophthalmology.

In presenting the A.O.A. proposal, the optometric representatives on the committee stated that it was illogical for an optometric delegation to discuss present or future policy making proposals of the profession before the representatives of the Guild of Prescription Opticians of America as this group is an openly admitted opponent of all things

optometrical. They also felt it was illogical for them to discuss these plans before the representatives of the Independent Optical Wholesalers Association, as such discussions were of little interest to the representatives of this association. Both the Guild and the Independent Wholesalers have representation on the committee. Admittedly, optometry has no quarrel or difficulty with the wholesale or laboratory people[3], and the relationships between optometrists and laboratory people are excellent. On the other hand the relationship between retail dispensing and optometry are subject to improvement.

Optometry contends that dispensing opticians have no place on a "professional committee" as their work is non-professional in character and scope, and is conducted solely as a business with an almost complete disregard for true professional ethics. Wholesale opticians are business men with little opportunity of adopting professional viewpoints in their conduct of their laboratories.

The dispensing opticians contend that they belong on the committee as they serve a portion of the public, and the writer believes that ophthalmologists generally support this position.

The opticianry groups now on the committee are disappointed and not pleased with the A.O.A.'s proposal, because it removes them from an interesting open forum in which much of interest is discussed. Because of their participation, the parent bodies they represent are assisted in keeping abreast of current plans and future planning in the entire field of eye care. The Independent Optical Wholesalers Association representatives point out that they are frequently in a position to bring optometrists and ophthalmologists together at local levels to consider mutual problems. They further point out that they have rendered important service in setting up State interprofessional committees on eye care. The representatives of all opticianry groups also point out that by serving on the committee they have access to the current leadership in both ophthalmology and optometry and that the reverse is also true.

* * * *

The third problem before the committee is presented by the retail dispensing opticians. This group, lead by the Guild, is now proposing that ophthalmology and optometry assist them in securing licensing laws in the various States. They point out that eight States now provide some sort of registration for retail dispensing opticians. They wish to expand this legal recognition into many other areas. They claim they

[3]Represented on the committee by Norman MacLeod of the McLeod Optical Company, Providence, Rhode Island, and by Leslie W. Myers, N. P. Benson Optical Company, Minneapolis, Minnesota.

need this legislation to raise the standards of opticianry and to protect themselves from attacks upon them by local optometric groups.

The A.O.A. representatives on the committee reply that the association is on record as opposed to such legislation on the grounds that it is unnecessary: the responsibility for glasses rests upon the prescriber and not the dispenser. They further point out that if the retail optical dispenser would conduct his business in a manner which does not discriminate against optometrists he has nothing to fear from local, State or national optometric societies. The attitude of the A.O.A. on this question is that many retail optical dispensers have not made any noticeable effort to change the philosophies underlying their business practices in recent years and certainly until they show substantial evidence of doing so, they do not merit assistance in securing the legislation they wish from national or local optometric societies.

The ophthalmologists on the committee, while not openly expressing a fixed policy, indicated at the meeting that they tentatively approve the suggestion of licensure for dispensing opticians, and their parent committee has appointed a subcommittee to consider standards for this group.

* * * *

These are the problems which are before the committee when it adjourned its October 1953 meeting. Whether these problems can be solved and just how to accomplish this task with the minimum of friction is now before us. It is evident to the writer that "smartness" or "cleverness" alone will not accomplish the job. As Chairman Culler has said, we must be idealists. It will require a return to the sense of mission and high purpose to solve these problems in the public's interest. The committee started out with these qualities and a strong sense of humor. The latter now seems lost and without some saving sense of humor much of lasting value is rarely accomplished.

Today there is discord among the organizations represented on the committee and it is useless to pretend otherwise. Some seem to think that discord which has always been must always be, no matter how serious the cost. At present the committee has reached an impasse. These proposals have been sent back to the parent bodies and the future of the committee rests upon their ability to solve these problems. Perhaps a re-examination of the proposals is necessary.

In any event, there is general hope that the leadership in optometry and ophthalmology will be able to agree on such courses of action which are mutually beneficial to all parties involved, keeping in mind what is best for the public whom we all serve.

CAREL C. KOCH.

TRANSACTIONS OF THE AMERICAN ACADEMY OF OPTOMETRY

A department devoted to announcements, reports, appointments, organization data news, professional problems and ideals, as these relate to the Academy.

PROGRAM—1953 ANNUAL MEETING

AMERICAN ACADEMY OF OPTOMETRY

The following speakers and topics will constitute the Program at the 1953 annual meeting of the American Academy of Optometry, Chicago, Illinois, Drake Hotel, December 5-8. This program is presented by the Papers and Program Committee, Dr. John D. Perry, Jr., chairman, Dr. Mathew Alpern, Dr. Eugene Freeman, Dr. Henry W. Hofstetter, Dr. Alfred Lit and Dr. Fred W. Sinn.

PROGRAM

Saturday, December 5, 1953

8:30 Registration.

10:00 Business Meeting.
President's Annual Report. Meredith W. Morgan, Jr., Ph.D.
Secretary's Annual Report. Carel C. Koch, O.D.
Announcements by Chairman of the Papers and Program Committee. John D. Perry, Jr., O.D.

11:00 The Design of Magnifiers for Use in Cases of Subnormal Vision. Edwin W. Bechtold, B.S. M.A., Associate Professor of Optometry, Columbia University.

11:30 Discussion.

11:40 A Group Screening Test for Visual Acuity. C. F. Schumacher, B.A., M.S., Research Assistant, Department of Psychology, Iowa State College, and A. R. Lauer, B.A., M.A., M.S., Ph.D., Professor of Psychology, Iowa State College.

11:55 Discussion.

12:05 Luncheon Recess.

1:30 The Use of Statistics in Visual Research. Francis A. Young, B.S., M.A., Ph.D., Department of Psychology, State College of Washington.

1:50 Discussion.

2:00 Inducement of Cyclofusional Movements. V. J. Ellerbrock, M.Sc., Ph.D., School of Optometry, Ohio State University.

2:30 Discussion.

2:40 Detailed Haploscopic Studies of One Subject. Meredith W. Morgan, Jr., Ph.D. Professor of Physiological Optics and Optometry, School of Optometry, University of California.

3:10 Discussion.

3:20 The Changing Attitude Toward the Blind and the Partially Sighted. Joseph I. Pascal, M.A., O.D., M.D., Director of Eye Department, Stuyvesant Polyclinic; Lecturer, N. Y. Polyclinic Medical School.

3:40 Discussion.

3:50 Visual Aids for the Legally Blind. Charles G. Ritter, Consultant on Special Aids and Appliances, American Foundation for the Blind, Inc., New York City.*

4:15 Discussion.

4:25 Optometric Rehabilitation of the Partially Blind. Eugene Freeman, Ph.D., Dean, Chicago College of Optometry.

4:55 Discussion.

*Aids and appliances for the blind to be on exhibition. Professional staff member of the Foundation will be in attendance at the exhibit.

5:10 Dinner Recess.

7:45 The Importance of The ACA Ratio in Industry and Schools. Fred W. Jobe, Director of Ophthalmic Research, Bausch and Lomb Optical Co.

8:05 Discussion.

8:15 The Torque P.D. Otto R. Engelmann, O.D., Chicago, Illinois.

8:35 Discussion.

8:45 An Investigation of the Relationship Between the Degree of Shape and Orientation Constancy, and the Difficulties Encountered by Patients in Adjusting to Changes in Cylinder Correction. George W. Knox, Ph.D., School of Optometry, Ohio State University.

Sunday, December 6, 1953

9:00 Section Meetings.
Aniseikonia ——— Room M-17
Contact Lenses ... Parlors FG
Occupational Optometry ——— Parlor C
Orthoptics ... Grand Ballroom
Pathology ——— Room M-18

11:00 Ocular Complications in Diabetes. Isadore Kaplan, M.D., Professor of Human Anatomy and Clinical Pathology, Pennsylvania State College of Optometry.

11:30 Discussion.

11:40 An Evaluation of the Biologic and Near-Work Concepts of Myopia Development. Francis A. Young, B.S., M.A., Ph.D., Department of Psychology, State College of Washington.

12:00 Discussion.

12:10 Chapter Luncheon. (French Room.)

2:20 Cataract and Its Etiology. Arthur Schlaifer, B.S., M.S., Ph.D., O.D. Assistant Professor of Optometry and Ocular Pathology, Pennsylvania State College of Optometry.

2:50 Discussion.

3:00 Near Point Visual Test for Schools and Industry. Glenn A. Fry, Ph.D., Director, School of Optometry, Ohio State University.

3:30 Discussion.

3:40 Visual Psycho-Neurosis. Emmanuel Gobeil, Opt. D., B.A., B.Ph. Chief of the Department of Optometry and Director of Visual Rehabilitation Clinic of the Hotel-Dieu Montmagny Hospital, Member of the Medical Staff and Professor at Montreal University.

4:10 Discussion.

4:20 The Effect of Luminance of the Contrast Inducing Flashes on the Spatial Range of Metacontrast.* Mathew Alpern, Ph.D., College of Optometry, Pacific University.

4:50 Discussion.

5:00 A Study of Visual Performance of Mentally Retarded Children. Morris Kirschen, A.B., O.D., Modesto, California.

5:20 Discussion.

5:30 Dinner Recess.

7:30 Symposium on 3-D and Wide Angle Movies. Mathew Alpern, Ph.D., School of Optometry, Pacific University, Presiding.
Speakers:

7:45 - 8:15 Cinerama, Cinemascope and 3-D. A discussion of advantages and limitations. Reuel A. Sherman, D.O.S., Director, Occupational Vision, Bausch & Lomb Optical Company, Rochester, New York.

8:15 - 9:15 Development of the Methods of Three Dimension Photography. Armin J. Hill, Ph.D., Staff Physicist, Motion Picture Research Council, Hollywood, California.

9:15 - 10:00 Some Physiological and Psychological Problems of Three Dimension Movies. Monroe J. Hirsch, O.D., Ph.D., Ojai, California.

10:00 - 10:30 Adapting motion picture developments for visual therapy in optometric practice. Daniel Woolf, Ph.D., School of Optometry, Columbia University, New York.
Discussion: Paul C. Foote, Optical Development Engineer, Bell and Howell Company, Chicago, Illinois.

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*Aided by a grant in aid from the Research Fund of the American Academy of Optometry.

Monday, December 7, 1953

9:00 Section Meetings.

11:00 Accommodative Response of the Eye to Electrical Stimulation of the Ciliary Ganglion in Cats. Elwin Marg, Ph.D., School of Optometry, University of California, and Johnie L. Reeves, 1st Lt., USAF (VC) Aero Medical Laboratory, WPAFB, Ohio, and Wallace E. Wendt, D.V.M., Cleveland, Ohio.

11:30 Discussion.

11:40 Latent Myopia in Exodeviations. John R. Kennedy, O.D., Burch Clinic, St. Paul, Minnesota.

12:10 Discussion.

12:20 Luncheon Recess.

2:00 Compensating Bifocals for Cases of Anisometropia. George A. Parkins, Opt.D., Ord, Nebraska.

2:15 Discussion.

2:25 Brightness Difference in Seeing. Sylvester K. Guth, B.S., E.E., D.O.S., and A.A. Eastman, B.S., E.E., General Electric Co., Nela Park, Cleveland.

2:55 Discussion.

3:05 The Ophthalmic Properties of Binocular Magnification Devices. Gerald Westheimer, Ph.D., College of Optometry, University of Houston.

3:35 Discussion.

3:45 Reading—A Developmental and Educative Process. Elizabeth A. Simpson, B.A., M.A., Director, Reading Service Institute for Psychological Services, Illinois Institute of Technology.

4:05 Discussion.

4:15 Business Meeting.

6:00 Cocktail Hour. Gold Coast Room (west end).

7:00 Annual Roundtable Dinner (formal) Gold Coast Room (east end). Presiding Officer: Meredith W. Morgan, Jr., Ph.D. Speaker: Charles Sheard, Ph.D., Rochester, Minnesota. Topic: Looking Backward, Then Forever Forward.

Tuesday, December 8, 1953

9:00 Section Meetings.

11:00 Torsions and Cyclophoria. Merrill J. Allen, B.Sc., M.Sc., Ph.D., Division of Optometry, Indiana University.

11:30 Discussion.

11:40 An Investigation of the Variations in Accommodation and Convergence Induced by Successive Spherical Lens Additions With the Description of a Clinical Method for Testing the Validity of the Refractive Correction. Merton C. Flom, M. Opt., School of Optometry, University of California.

12:10 Discussion.

12:20 Luncheon Recess.

1:45 The Relationship Between Aniseikonia and Achievement in Reading. Alfred A. Rosenbloom, Jr., B.A., M.A., O.D., Northern Illinois College of Optometry.

2:15 Discussion.

2:25 The Chronometric Technique: A New Approach to Binocular Analysis. Z.J.B. Schoen, D.O.S., Ph.D., Chicago College of Optometry.

2:55 Discussion.

3:00 to 5:00 Open House. Reading Clinic of the University of Chicago. Helen M. Robinson, Ph.D., Director.

3:05 The Preparation and Development of a Dictionary of Visual Science. Max Schapero, O.D., Los Angeles College of Optometry, David Cline, B.S., Los Angeles College of Optometry, and Henry W. Hofstetter, Ph.D., Division of Optometry, University of Indiana.

3:25 Discussion.

PROGRESS REPORT—SHEARD COMMEMORATIVE VOLUME

During October, the committee working to raise the necessary funds from the *friends of Sheard* to publish the Sheard Commemorative Volume, reports progress. On October 26, the optometric committee had secured 352 pledges for a total of $5,698.25. The other committees in opticianry and ophthalmology report having about 140 pledges for approximately $1,750.00. The campaign goal of $8,000 is now in sight and on behalf of this splendid commemorative project all readers who have not already subscribed are urged to take part.

The Commemorative Volume will contain many of the early papers on refractive subjects, binocular vision and ophthalmic optics by Dr. Charles Sheard. In addition it will include the list of contributors who made the volume possible. Subscriptions in amounts of $10 to $25 are invited. Each subscriber will receive a prepaid copy of the book when printed. 300-400 pages, cloth bound. Send your subsciption to, "Sheard Commemorative Fund—American Academy of Optometry," 1502 Foshay Tower, Minneapolis 2, Minn. Do this today in honor of one of the great educators in visual science.

The Committee members working on this project are as follows:

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CURRENT COMMENTS

Terry Judith Parkins
Editorial Assistant

Optometrists will confer a favor by sending news items of general interest for this department, such as relate to new instruments, clinical techniques, education, visual health and optometric legislation and organization.

UNGRATEFUL DENTISTS

At the recent meeting of the American Dental Association in Cleveland a number of harsh things were said about dentifrice advertising. Dentists pointed out that present day advertising claims for some toothpaste products have become so fantastic as to hold the entire profession up to ridicule. The association demanded an about-face on the part of the offenders and are now prepared to crack down on any who refused to modify the claims for their product.

ADVERTISING AGE comments on this action. In its lead editorial[1] it agrees that some dentifrice copy is open to question. On the other hand it finds dentists ungrateful for the help they have received over the years from these very advertisers. The editor says:

"Nevertheless, we are fed up (today, anyhow) with the smugness of the professional boys who see nothing but evil in advertising, and we are particularly annoyed at any smugness in this area emanating from the dental profession.

"The plain unvarnished truth is that the makers and advertisers of dentifrices have done more to advance the cause of dental health, and the economic prosperity of dentists, than any other single group in the population—not excluding the dentists and the American Dental Association.

"*See your dentist* has been so integral a part of all dentifrice advertising for 25 years or more that this advertising has been, in our opinion, the most important factor in raising the level of the dental profession from a pretty low estate, and in spreading the doctrine of dental care and dental health among more and more people . . . let's have a cessation of senseless beating of advertising over the head, and a bit of acknowledgment of some of the good it has accomplished."

From a sister profession we have several observations on this. These are, that better education was the major factor in bringing dentistry up the ladder of professional standing. Next, the desire of dentistry to clean up the commercial element, so in evidence 25 years

[1]Advertising and Ungrateful Dentists. Editorial. Advertising Age. October 12, 1953, p. 12.

ago, and its success in accomplishing this, and last, the day-in and day-out help dentistry received from these dentifrice manufacturers who pounded home the need for seeing a dentist at regular intervals. *Combining* these made progress possible.

And, too, we can only wish that our own Better Vision Institute had ten times its present budget for advertising, to enable it to do the same job for us with the public in the field of visual care. It could, too, if everyone would support it properly.

BARTLEY SPEAKS BEFORE INDIANA CHAPTER

Howard Bartley, Ph.D., Michigan State College, was the speaker at the October 25 meeting of the Indiana Chapter, American Academy of Optometry at Purdue University, West Lafayette. His paper was "Fatigue, as it Relates to the Optometric Field." In addition four recently published original papers from this Journal were reviewed by Drs. C. F. Mackey, H. Jenner, D. Berkebile and C. D. Jordan. The meeting was open to all members of the Indiana Optometric Association.

MURROUGHS' REPORT ON ORTHOPTICS

Last December at the 1952 annual meeting of the Academy, Dr. Ted R. Murroughs, faculty member, Northern Illinois College of Optometry, presented a report on orthoptics which was well received by our Section on Orthoptics. At their request this material was mimeographed and mailed to those present at the Section meeting. A few copies (40) remain. As long as they last these may be had without cost, by addressing a request to Dr. Thaddous R. Murroughs, Northern Illinois College of Optometry, 830 East 42nd Place, Chicago, Illinois.

REJOINDER FROM THE GUILD

During the summer months we ran a two-part report by editor Koch[1] on "Problems with Dispensing Opticians." Henry B. Carpenter, Past President of the Guild of Prescription Opticians of America has now replied to this report, his comments being published in the October, 1953, issue of GUILDCRAFT, the official publication of the Guild. As most optometrists do not read GUILDCRAFT, editor Koch has asked Dr. Eugene Freeman, Dean, Chicago College of Optometry, and a member of our Editorial Council, to review the Carpenter[2] material, as he feels that our optometric readers are entitled to know how the Koch report was received by Guild dispensing opticians and what their reactions

[1]Koch, Carel C. Problems with Dispensing Opticians. Part I. Improper Promotional Activities. Am. J. Optom. & Arch. Am. Acad. Optom. 30.6.318-325.1953. Part II. The Referral Question. Am. J. Optom. & Arch. Am. Acad. Optom. 30.8.438-443. 1953.

[2]Carpenter, Henry B. Is There a "Pattern"? Guildcraft. 27.10.23-34.1953.

were. Dr. Freeman's summary and comments will appear in either our December, 1953, issue or our January, 1954, issue.

OPTOMETRIC-CIVIL DEFENSE PROGRAM IN NEW JERSEY

A plan to utilize optometrists in the state's civil defense program has been distributed to area directors by the New Jersey Division of Civil Defense. Developed in cooperation with the New Jersey Optometric Association, the program calls for optometrists to establish emergency visual care stations for 24-hour duty in the event of an atomic attack.

Civil defense workers, unable to perform assigned duties because of lost or damaged eye glasses, would be given priority at such stations where optometrists would examine their eyes and new glasses would be made and given to them. All persons in need of visual care would be channeled to emergency visual care stations where they would receive attention after civil defense workers had been cared for.

State Civil Defense Director Leonard Dreyfuss, in announcing the plan, said it was developed by a committee of the New Jersey Optometric Association composed of Drs. Leon S. Deutsch, E. C. Nurock, and Andrew F. Fischer who will serve as advisors on the state level to Dr. Daniel S. Bergsma, director of the civil defense medical and health program.

Under the plan, the following doctors have been named to work on the area level as members of the state staff under the direction of the area medical officer:

Dr. Norman Tursh, Paterson; Dr. Murray Lane, Jersey City; Dr. Ernest E. Linke, Orange; Dr. Samuel M. Lonsk, Linden; Dr. Monte E. Barron, Morristown; Dr. Albert H. Kohn, Flemington; Dr. Harry Ehrlich, New Brunswick; Dr. Dante A. Antonucci, Trenton; Dr. Howard Donowitz, Freehold; Dr. Leonard Baker, Burlington; Dr. Harold Simmerman, Wenonah; Dr. Pasquale A. Spinelli, Hammonton, and Dr. S. M. Gerson, Millville.

On the municipal level visual care stations will be established at locations where optometrists' equipment is readily available or can be pooled for emergencies. Local directors of civil defense will develop this phase of the program with their area directors, Dreyfuss said. Optometrists named to the area staffs took their loyalty oaths and were sworn into civil defense at a special meeting called by Dreyfuss for October 21, in the Veterans Room of the War Memorial Building in Trenton.

COLUMBIA UNIVERSITY STUDENT RESEARCH PAPER

The October meeting of the New York Academy of Optometry was held October 20 at the Midston House, New York City. The speaker of the evening was Dr. Robert Wilder, recent graduate of the

School of Optometry, Columbia University, who presented a paper, "Differences in Accommodation Levels Between Two Eyes Under Conditions of Assymetric Convergence." This paper was adjudged the best of the recent graduating class, by the faculty of Columbia University, School of Optometry.

BEVERLEY MYERS NELSON ACHIEVEMENT AWARDS

Jack C. Copeland, O.D., of Chicago, Illinois, and William L. Benedict, M.D., of Rochester, Minnesota, received the Beverley Myers Nelson Achievement Awards in Ophthalmic Optics at the October 12 meeting of the American Board of Opticianry at Chicago. The awards consisted of engrossed parchments and honorariums. The awards were presented by Mr. Leslie W. Myers of Minneapolis, Minnesota, who established the awards in memory of his daughter and as part of the Educational Foundation of the American Board of Opticianry.

MARG SPEAKS BEFORE SAN FRANCISCO BAY AREA CHAPTER

The October meeting of the San Francisco Bay Area Chapter, American Academy of Optometry was held October 15 at the University of California School of Optometry. The speaker of the evening was Elwin Marg, Ph.D., Assistant Professor of Optometry at the U. C. School of Optometry, who presented a paper, "Accommodative Response of the Eye to Electrical Stimulation of the Ciliary Ganglion in Cats," based on research conducted with Lt. Johnie L. Reeves and Capt. Wallace E. Wendt during Dr. Marg's recent tour of duty at the Aero Medical Laboratory, Wright-Patterson Air Force Base, Ohio.

Elected to associate membership in the Chapter at the meeting were Drs. Robert W. Lester, San Francisco; Sigmund D. Sabin, Berkeley; Curtis F. Nagel, Berkeley; Allan H. Kaufman, El Cerrito; Jin S. Ong, Berkeley, Lt. Arthur Rosen, United States Army Medical Service Corps., and Lt. George E. Garcia, United States Army Medical Service Corps.

AIR FORCE-MEDICAL SERVICE CORPS

The Air Force Medical Service will have a Chief of the Medical Service Corps for the first time since its formation in July, 1949. The first officer to hold this position will begin his appointment as of November 1, 1953. Colonel Phillip G. Fleetwood, recently assigned in the Office of the Surgeon, Air Training Command, has been named to fill the new post by Major General Harry G. Armstrong, Surgeon General, USAF. The Medical Service Corps within the Air Force Medical Service includes medical administrators, pharmacists, optometrists, sanitary engineers, and the medical allied scientists.

BOOK NOTICE

GLAUCOMA PATHOLOGY AND THERAPY. Paul Weinstein and Julius Foldes. Published by the C. V. Mosby Company. St. Louis, Missouri. 295 pages, 36 illustrations. Cloth. $8.00. 1953.

This book was written to bring together in one volume a complete review of glaucoma pathology and therapy. To accomplish this task required the separation of significant from nonsignificant facts in the vast amount of literature on this subject. This required experience, a wide knowledge of many languages, superb judgment, and time to do the task properly. Professor Paul Weinstein, of the University of Budapest, appears to have accomplished this undertaking in a scientific and most satisfactory fashion.

The book was translated from the original Hungarian language by Dr. Julius Foldes, a diplomat of the American Board of Pathology and Fellow of the College of American Pathologists.

This book by Weinstein is not intended for the novice. Rather, it is designed for investigators and others in research who need a concise and accurate guide to the latest literature in the world on this very important subject.

The book would be very useful to optometrists who wish to gain a clearer insight into this complex disease than ordinarily provided in a textbook on ocular pathology or diseases. For example, in a discussion on the etiology of glaucoma, the author states: "Increase of the ocular tension is but one of the factors in the pathomechanism of glaucoma simplex. We know that in many cases visual field and acuity get worse despite normalization of ocular tension by conservative or operative treatment. Therefore, besides increased ocular tension, retinal vascular factors exert considerable influence in the causation of simple glaucoma."

Also, of special interest to optometrists is the chapter on the therapy of glaucoma. In it the local as well as general medical treatment comprehensively is discussed. The use and rationale of various types of therapy and surgery also is reviewed. Among the surgical treatments considered are iridectomy, posterior sclerotomy, cyclodialysis and cyclodiathermy. The author also discusses the indications as well as contraindications for surgical intervention in the disease.

Without reservation, the book is recommended to anyone who seriously desires to markedly increase his knowledge about this powerful enemy of human sight.

V. J. ELLERBROCK.

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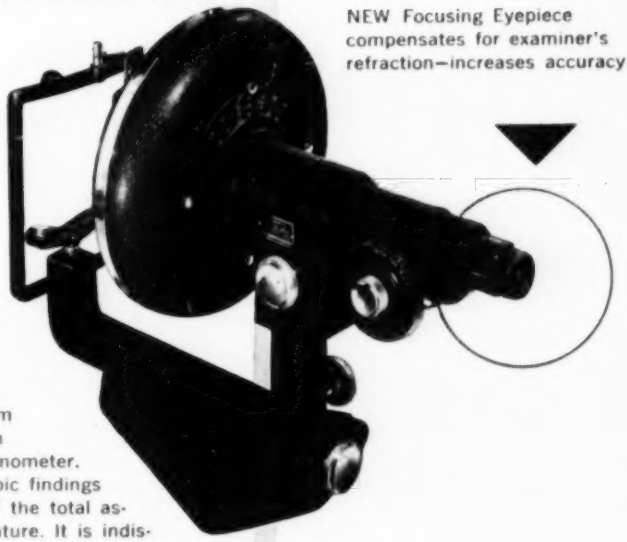

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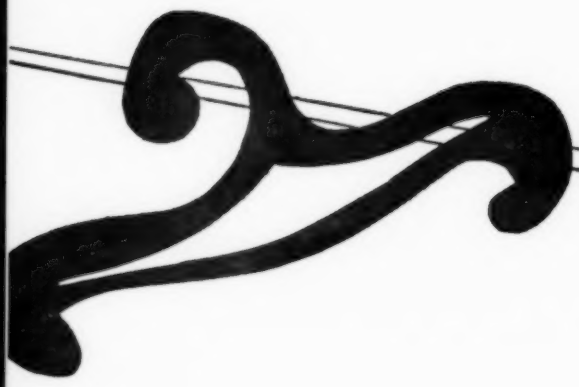

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